MAY 1927—THIRTY-THIRD YEAR

MACHINERY

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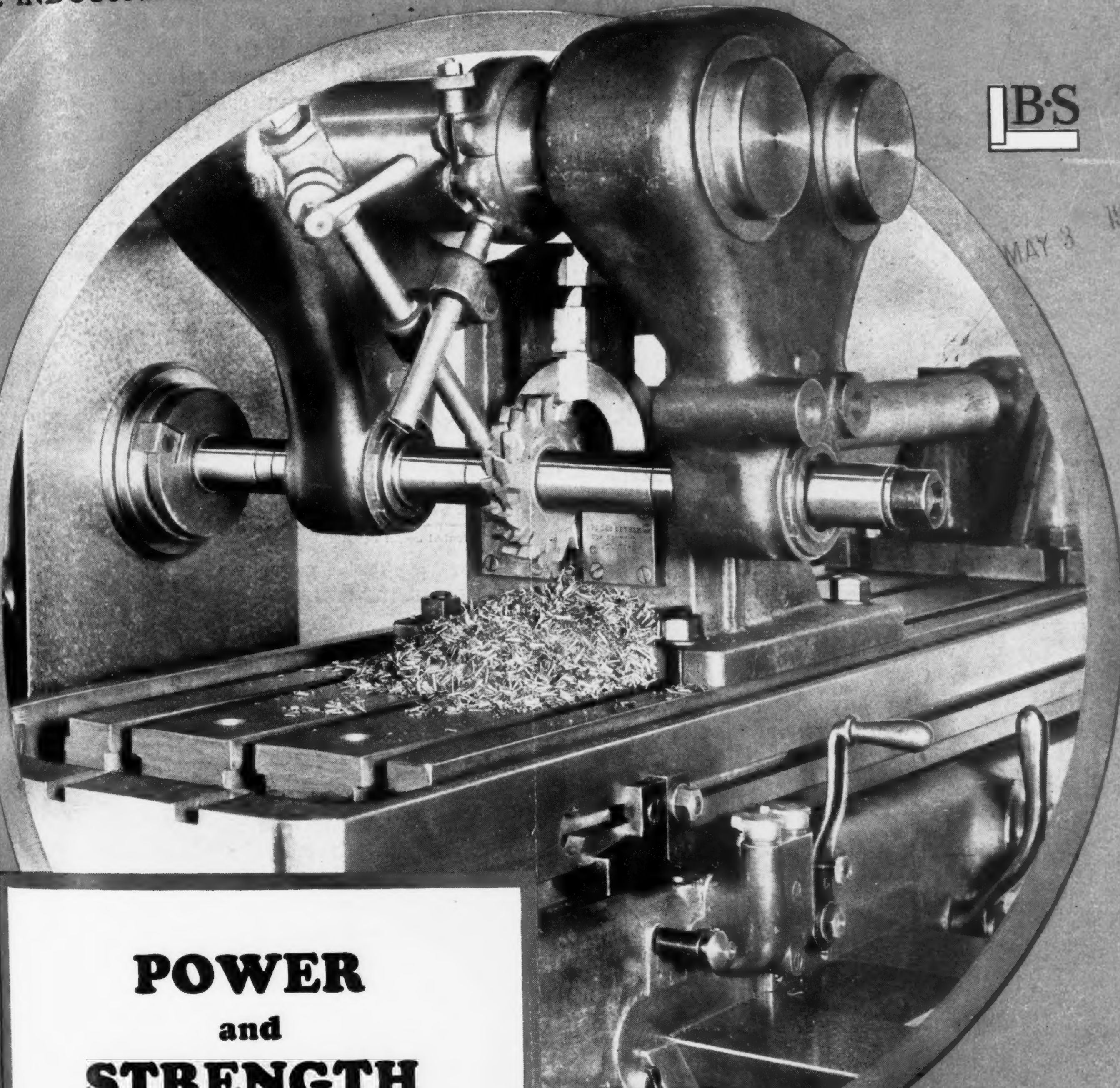

MACHINERY

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Cutting Handling Costs

The installation of labor-saving production machinery is not the only means of saving money in manufacturing plants. Handling material adds costs, often in small, unnoticed items of time; but the aggregate is considerable. The United States Census of Manufactures shows that over twenty per cent of the payroll in the manufacturing industries is for the handling of materials. In plants where it is impracticable to install the more expensive conveyor systems frequently it is possible to reduce the cost of handling materials by installing efficient hoisting and trucking equipment and by the rearrangement of machines.

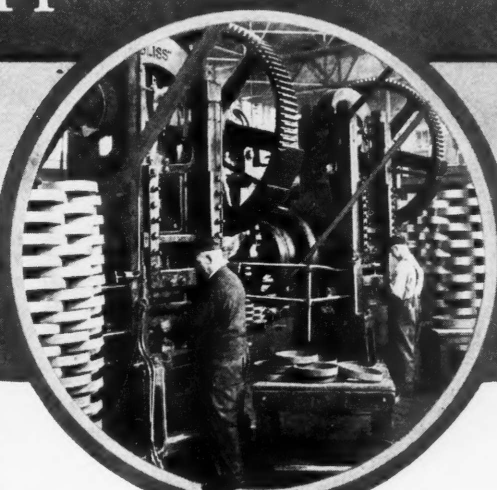
A detailed study of your plant probably will reveal some changes in handling that will save money. First, it should be remembered that economy in moving materials is secured by *not* handling them, and before considering the purchase of new conveying equipment, the present amount of handling might be reduced by the rearrangement of supplies and machines. Of course, all material, as far as possible, should be moved in one direction only and, if practicable, down grade.

Loading platforms should be at the same height as the tailboard of incoming and outgoing trucks. Simple sheet-metal chutes can be made to take parts from one machine to the next. Elevating trucks should replace the ordinary shop trucks. Electric hoists perform cheaply and rapidly the work of many men lifting heavy parts on and off machines; and overhead hand-operated monorails provide a cheap, easy means of transporting goods where floor space is valuable, or where there are a number of rises and drops to different levels.

Take time enough to look over carefully every handling detail in your plant. Probably it will save you money.

MACHINERY

What Happens in Shearing Metal



Analysis of the Action of Metal in Shearing, Blanking, or Punching—Factors Affecting Pressures Required and Results Obtained

By E. V. CRANE, Staff Engineer, E. W. Bliss Co., Brooklyn, N. Y.

AN analysis of the action of metal in shearing, blanking, or punching and a discussion of the various modifying influences will be presented in an effort to clarify one of the basic problems in the press-working of metals. The author has in mind principally hot- and cold-rolled steels of various analyses and physical characteristics. Their structure is crystalline, though with a thin amorphous intra-crystalline binding material, which is stronger than the crystals themselves under the conditions of quick action and normal temperatures in which we are interested.

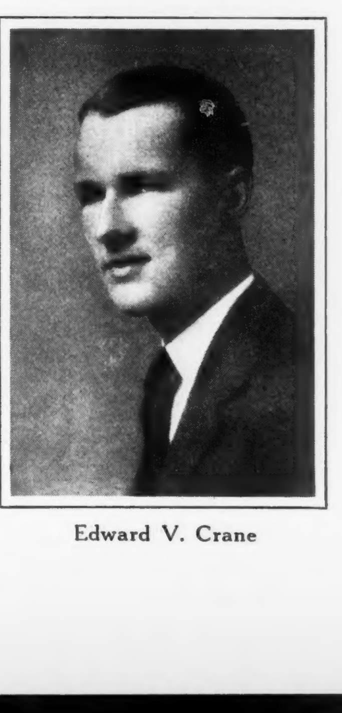
When the elastic limit of the material is exceeded, permanent deformation occurs in the form of movement along the slip planes through the crystals. Owing to the variation in size and relative positions of the crystals, slip occurs at different times and speeds and in different directions in the different crystals. When overstresses occur which exceed the cohesive strength of the crystal fragments, fractures start which spread, following the path of least resistance and greatest strain. This accounts for the irregular appearance of the fractured portion of a sheared edge and for the minute crevices remaining to start further fractures.

The principal factors affecting shearing work are thickness and physical properties (especially hardness) of the metal; size, shape, subsequent operations, tolerances, and finish of the job; and clearance, shear, relief, and condition of the tools. Press selection is also of extreme importance, but that should be considered as a separate subject. Most of the variables mentioned can be isolated sufficiently to ascertain their characteristics and effects. The various samples and some of the curves to be referred to were selected from experimental results obtained in the E. W. Bliss Co.'s laboratories.

Shearing Action in Blanking a Disk

The blanking of a disk from sheet material has been taken to illustrate shearing action. Fig. 1 shows a disk (soft 1/4-inch hot-rolled steel) blanked and cut in half to show the curvature toward the edge. The diagrams in Fig. 5 show the stages of the punch progressing through the sheet to illustrate the action upon the metal in shearing.

The upper diagram represents the stage at which the elastic limit of the material is just beginning to be exceeded, the principal load being bending. In the second diagram, the punch has penetrated just far enough to start the fracture. There is a normal pinching or compressive stress between the edges of the punch and die, and a tensile stress along the strata lines. The metal has been elongated locally along all these lines, and especially in the top and bottom strata. Here the ultimate strength has been exceeded over the corners and fracture has started. As the punch advances (see lower diagram), the fractures spread quickly from each edge, the load dwindling finally to what is necessary to overcome friction in pushing the blank through the die. Note that the blank as shown in Fig. 1 is inverted with reference to Fig. 5. However, the amount of penetration before the fracture



Edward V. Crane

EDWARD V. CRANE took his graduate and later his post-graduate degree in mechanical engineering at Yale University. His post-graduate thesis dealt with the subject of the design of power presses and outlined methods of corelating various types and sizes of presses to admit of economy in patterns through an interchangeability of parts. For the last seven years Mr. Crane has been connected with the E. W. Bliss Co., Brooklyn, N. Y., as staff engineer, and has handled a variety of work, including experimental and development work, the preparation of catalogues, and sales engineering work on special machinery and press equipment.

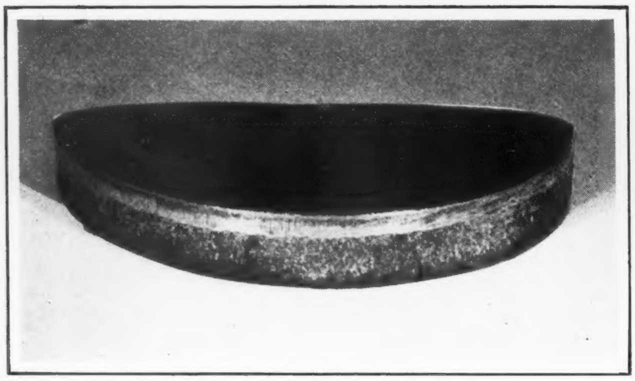


Fig. 1. One-half of a Disk Blanked from 1/4-inch Soft Steel, Using Punch and Die Having Proper Clearance

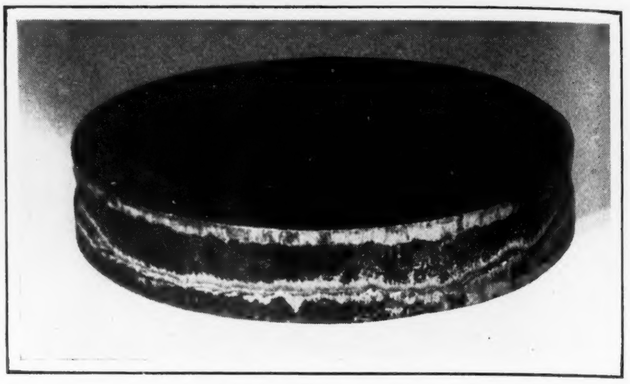


Fig. 2. A Disk Blanked from 1/2-inch Soft Hot-rolled Steel, Using Punch and Die Having Insufficient Clearance

starts, which is indicated by the burnished part of the edge on the blank, is about the same in each case; so also is the edge deformation.

Effect of Clearance between Punch and Die

The first example, just referred to, represents practically an ideal condition for shearing, as regards clearance (distance between die and punch all around). The two fractures met, giving a clean break and a minimum power requirement. In Fig. 2 is shown a disk blanked with insufficient clearance for its thickness and softness. Fig. 6 illustrates what occurs. The fractures start from the corners, as before, when the surface material has been elongated beyond its ultimate strength. Instead of meeting, however, they pass, leaving a ring of material which must again be stressed to the point of fracture, with a further expenditure of energy; also there is a ragged fringe left around the disk, which tends to wedge against the die as it is pushed through, adding to the power required.

There is a "rule of thumb" that the clearance should be about one-eighth to one-tenth of the thickness of the material, depending upon its hardness. Hard stock does not require nearly so much clearance for a clean fracture as soft stock. Fig. 3 shows a disk sheared from comparatively hard cold-rolled steel, using the same die and punch (the same clearance) as were used for the disk shown in Fig. 2. Note, however, that the fracture is very much cleaner; also due to the hardness of the metal, the burnished band which indicates the depth to which the punch penetrated before fracture occurred, is very narrow.

A tensile test of such material indicates that the elongation before fracture occurs is very little. Thus, as illustrated in Fig. 7, the punch enters but a short distance, stretching the surface strata comparatively little before the fractures start. And, again, due to the hardness of the material, the break is completed almost instantly, so that the disk is completely severed before the punch has entered more than a quarter of the thickness of the stock. For softer metals, the punch must enter farther to cause fracture, in some cases even passing all the way through the sheet and actually pinching the blank out.

A little variation in clearance around a die makes the difference between a clean fracture and a poor one. A clean fracture causes less wear on the dies, and insufficient clearance may become so small as to permit of actual contact between the cutting edges. It is well known that cutting part blanks may cause breakage or at least excessive wear on punches. Off center spring, due to unbalanced loading in too light a press, is equally capable of shifting the clearance with detrimental effect on the tool life.

Pressure and Power Variations

The disk shown in Fig. 4 was one of a group blanked in an Olsen testing machine, with load readings taken every 0.005 inch. This particular disk may be classed with Figs. 2 and 6, since there was not sufficient clearance between the punch and die to permit a clean fracture. The material was about 0.12 per cent carbon hot-rolled plate, 0.245 inch thick, showing, when subjected to a tensile test, an elastic limit of about 32,000 pounds per square inch, an ultimate strength of about 47,000 pounds per square inch (on the original area), and an elongation of about 27 per cent in 2 inches. The

Fig. 3. Moderately Hard Disk Showing Shallow Penetration and Clean Fracture—Same Clearance as for Fig. 2

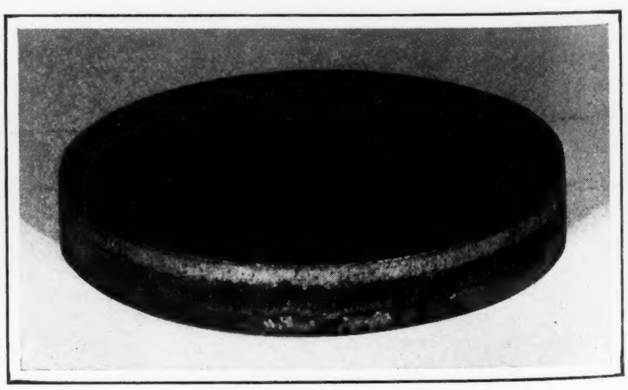


Fig. 4. Disk Blanked in Olsen Testing Machine—Another Example of Insufficient Clearance

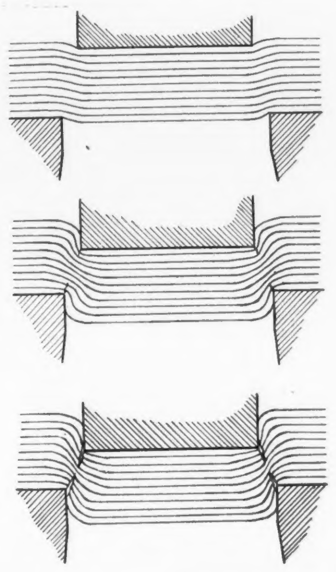


Fig. 5. Diagrams Showing Shearing Action when Punch and Die Have Proper Clearance

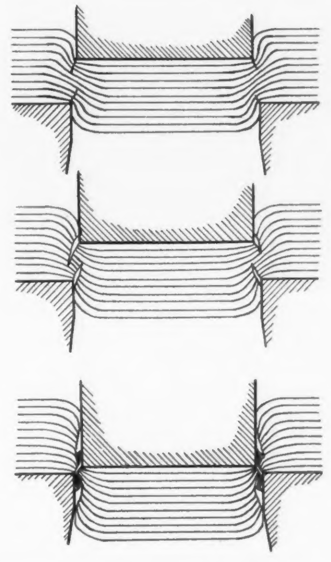


Fig. 6. Shearing Action when Punch and Die Have Insufficient Clearance

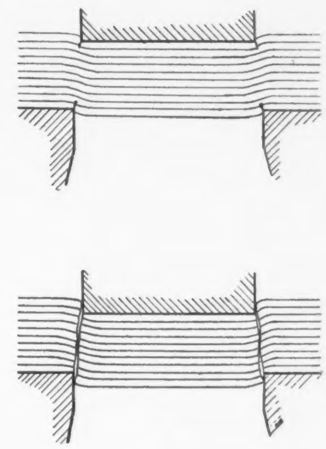


Fig. 7. Shearing Action in Blanking a Moderately Hard Steel Disk

diameter of the punch was 1.434 inches, and the stress on the metal actually in shear at the point at which the fracture started figured about 53,000 pounds per square inch (which on the original area, amounts to 39,000 pounds per square inch).

In Fig. 8 is shown the curve obtained from this test, which indicates the way in which the pressure rises to the elastic limit, holds constant as the area is reduced until fracture starts, and then falls away. The hump on the way down is due to a repetition of the shearing action, since the clearance was insufficient for the original fractures to meet. A cross-section of the edge of the metal is shown above the curve and drawn to the same scale, so that the change in load may be compared with the progress of the punch.

Figs. 9 and 10 are arranged in the same way and to the same scale as Fig. 8 to permit easy comparison. Fig. 9 illustrates the effect of blanking the same soft material as before, but, in this case, with suitable clearance in the die. This is the same condition as was illustrated in Figs. 1 and 5. Fig. 10 shows conditions prevailing in blanking hard material of similar actual ultimate strength to that previously used. (See also Figs. 3 and 7.) The pressure required to cause fracture is greater than for the softer steel, but fracture begins sooner, and once started, is more quickly completed. The clearance is less than in Fig. 9, but is ample for the material.

To illustrate the visible relation between hardness and depth of penetration, compare the relation between the thickness of the disk and the depth of penetration before fracture (indicated by the depth of the bright band around the edge) in Figs. 1, 2, and 3. The penetration before fracture was in the nature of 30 per cent of the total blank thickness for Fig. 1, 16 per cent for Fig. 2, and 8 per cent for Fig. 3. The Shore scleroscope hardness numbers were 19 for Fig. 1 (the softest and

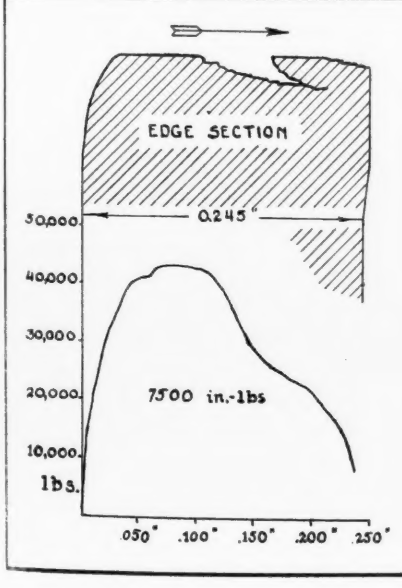


Fig. 8. Load Curve for Disk Shown in Fig. 4, and Cross-section of Blanked Edge

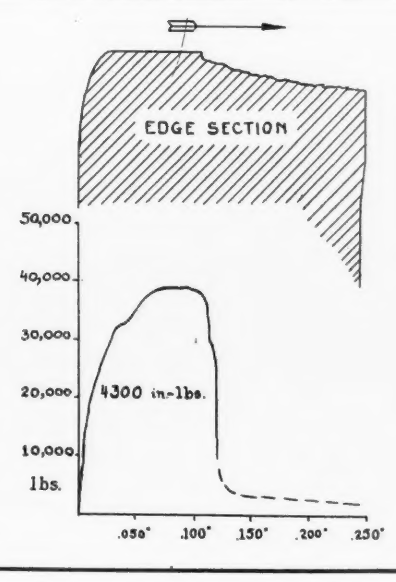


Fig. 9. Load Curve when Punch and Die Have Suitable Clearance

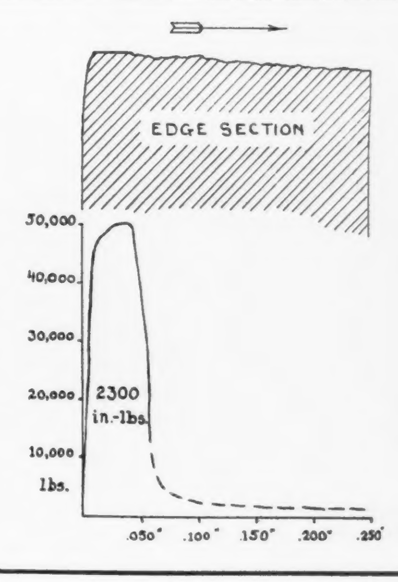


Fig. 10. Load Curve for Fairly Hard Steel and Suitable Clearance

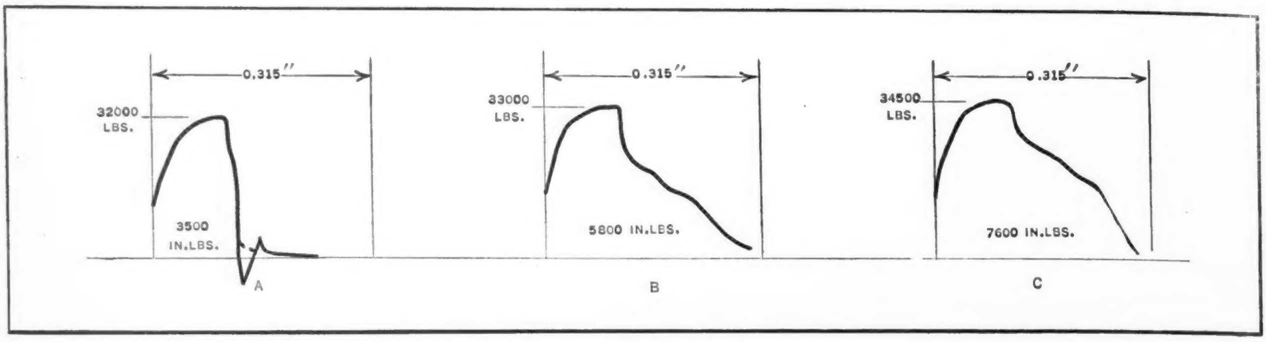


Fig. 11. Curves Showing how Reduction of Punch and Die Clearance Increases Maximum Blanking Pressure and Decidedly Increases Power Required for Blanking

the most deeply penetrated); 21 for Fig. 2; and 26 for Fig. 3 (hardest with least penetration).

The energy required to perform the work of punching out the blank is represented in each case by the area under the curve. The common method of approximating this value would be to figure the force required, at about 25 tons per square inch, on the area to be sheared, and multiply it by the thickness of the stock. This gives about 13,500 inch-pounds, whereas the actual power consumed varied from about one-sixth (Fig. 10) to a little over one-half (Fig. 8) of this theoretical value.

Fig. 11 shows three indicator diagrams taken from a report by Professor Gardner C. Anthony of his investigations in punching boiler plate. The equipment used was an Olsen testing machine with a hydraulic cylinder connected with a regular steam engine indicator. These diagrams were taken while punching mild steel plate 0.315 inch thick. The die diameter was 0.767 inch, and the punch diameters were 0.702 inch for card *A*, 0.738 inch for card *B*, and 0.750 for card *C*. The clearance between the punch and die, in per cent of metal thickness, was 10.3 per cent for card *A*, 4.6 per cent for card *B*, and 2.7 per cent for card *C*.

Card *A* is quite typical of a clean fracture with proper clearance. The jump of the indicator pencil at the bottom of the fracture was probably due to spring in the machine as the break released the pressure. Decreasing the clearance below the proper amount for the metal caused an increase both in the maximum load (required to cause fracture) and in the power requirements, shown in inch-pounds on the diagrams.

Condition of Sheared Edge

The condition of the edge of the sheet, blank, or strip after the shearing action explains a number of points in press operations. Examine, for instance, the edge as shown in Figs. 1, 5, and 9. Note that the unsupported surface of the metal is drawn down in an easy curve to the edge. Then follows the polished portion of the edge, indicating the depth of penetration before fracture occurs, which is drawn smooth against the surface of the die or the punch. The remainder is the rough fractured surface containing many fine crevices and breaks which will serve as the starting point for further fractures. Where the fracture joins the other surface, the edge may be either a square break, if the tools are sharp, or a jagged burr, if they are worn.

In Fig. 12 are shown two tensile test specimens, illustrating the greater inherent strength of a smooth edge over a fractured edge. The two strips were sheared from 1/4-inch black sheet to 1 inch wide. A light cut was taken in a shaper across the edges of one, while the edges of the other were left as sheared. Both were then stressed in tension almost to the breaking point, showing a similar elongation averaging about 26 per cent. The specimen with the finished edge took a greater stress (by perhaps 8 per cent) than the other, and necked in smoothly as it approached its ultimate strength, without fractures appearing.

The specimen with the edges left as sheared, began to show, at a fairly early stage, many small fractures starting from the edge of the portion fractured in shearing. These opened up, as an examination of the illustration will show, until one spread nearly across the specimen, and did so before appreciable "necking in" had occurred. Note especially that the fractures did not start from the corner drawn down and burnished by the penetration of the cutting edge.

Obviously, the designer must avoid the coincidence of a fractured edge and a high stress either in a severe press-working operation or in a part liable to failure in fatigue. There are ways of re-

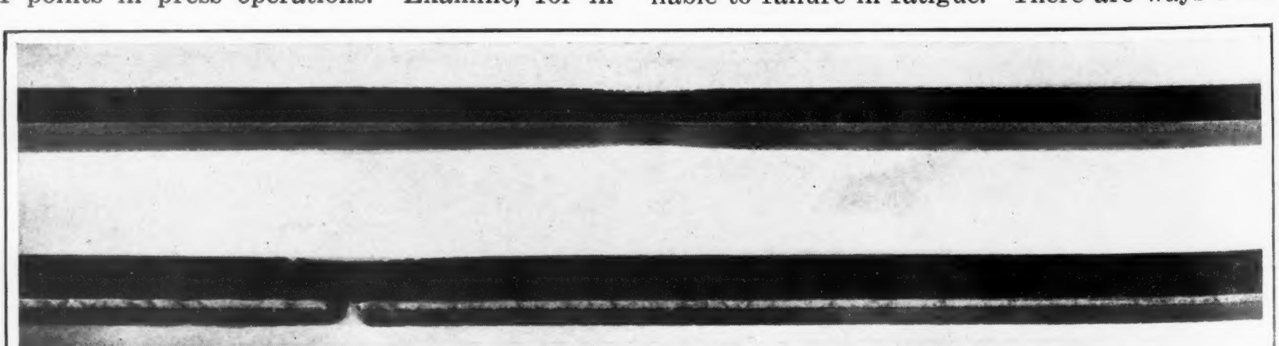


Fig. 12. Upper Specimen Having Machined Edges Withstood Tensile Test Better than Lower Specimen Having Sheared Edges

ducing the hazard, such as arranging to take the severest stress on the burnished portion of the edge, or burnishing or machining the fractured portion.

A case in point is making a severe bend in strip or sheet material having a sheared edge. If the burnished portion of the edge be kept on the outside, a fairly severe bend can be made without a break. However, if the fractured portion of the sheared edge is on the outside of the bend, the tensile strain in the outer strata will be very likely to open up minute fractures already existing, into cracks apparent to the eye.

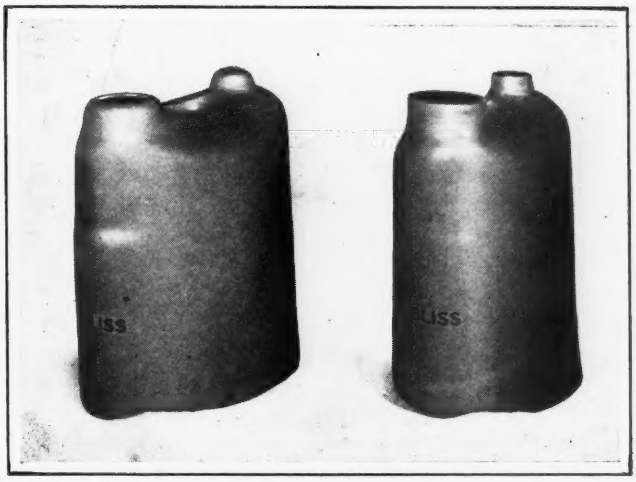


Fig. 13. In Expanding Metal Around Holes of Shell Seen at the Left, to Obtain Enlargements Shown at the Right, Outer Edges Subjected to Greater Stresses Must be Smooth to Prevent Fracture

Fig. 13 illustrates the operation of "burring" or flanging out metal around the edge of a hole at the bottom of a drawn shell. Clearly the operation is akin to expanding. As the metal is forced out into the flange, the circumference of the hole increases and the metal around the edge is stretched, especially around the outer diameter of the edge.

When the holes shown in the shell at the left were drilled so that the edge was left smoothly finished, there was no trouble in "burring" out, as shown at the right, without starting cracks; however, when the holes were punched out with the dies on the outside and the punches on the inside, the condition was quite different. The burnished penetration band was on the inside, and the outside edge of the hole, which must stand the greatest tensile stress, was a raw fracture. When expanded severely, the minute crevices in the fracture opened up into objectionable cracks which spread quite deep. This was overcome by filing a slight chamfer around the outside edge of the hole, removing the fractured surface. Had it been possible to punch the holes through the other way, so that the burnished penetration band was around the outside edge, this filing would have been eliminated.

It is well established that fatigue breaks will develop from existing fractures. It is also known that punched rivet holes are objectionable in some classes of riveted work, due to the danger of fatigue failure, whereas drilled holes are free from this objection. Evidently, the fractured portion of the sheared hole is the starting point for the fatigue fracture. It would prove an interesting experiment to see whether a burnishing shoulder on the punch, equal in diameter to the die, would not overcome this danger. It is also problematical at this time whether attention to the condition and direction of the sheared edge would not reduce the scrap loss due to cracking on some severe drawing operations.

A good illustration of the importance of the direction of shearing metal is found in curling or wiring operations. Every good diemaker knows that the burr should come on the inside of the curl for the best results. In some cases, this is absolutely essential, though in others, such as double seaming, it makes no difference. Fig. 14 shows a cross-section through a curling die and the metal edge. Here the burnished and slightly rounded corner of the metal edge is sliding against the surface of the curling die or chuck. If the fractured corner was the one to come in contact with the die, the metal would crumple and upset the wrong way in many cases, instead of curling.

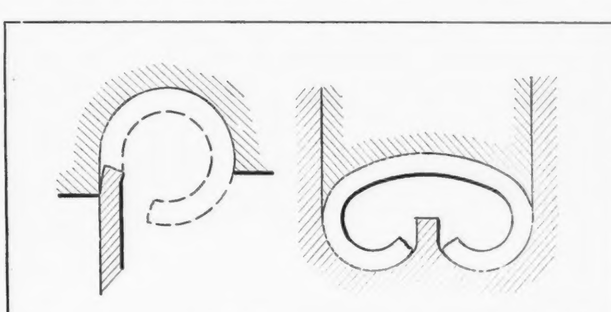


Fig. 14. In Curling or Wiring Operations, Burnished Edge of Metal Should Slide against Die

Where to Apply Clearance—Shear on Punch or Die

In blanking or punching accurately to size, the clearance must obviously be taken into account. Fig. 5 is a good illustration of this point. The die is larger than the punch by an amount sufficient to give a clean fracture. Note that if the hole is to be held accurately to size, the punch must be that size, and the amount of the clearance added to it to determine the die size. Conversely, if the disk or blank must be punched to an accurate size, that is the size of the die. The clearance allowance would then be deducted from this to determine the punch size.

It is fairly common practice to give a die or punch shear by beveling off the face at a slight angle, so that cutting does not occur on the whole cutting edge at once, thereby reducing the peak load. In this case, note that the metal follows the contour of the punch or die, depending upon which has shear. If a flat blank is desired, the punch should be flat and the shear should be on the die, where it will deform only the scrap. Conversely, if a hole is being punched in a sheet so that the metal punched out is the scrap, the die should be flat and the shear should be on the punch.

While discussing shear, it is well to comment that the conventional method of figuring it, although safe, is too inaccurate for particular applications. In Fig. 15, at *A* is an illustration commonly used to represent full shear; that is, beveling one cutting edge with respect to the other by an amount equal to the thickness of the

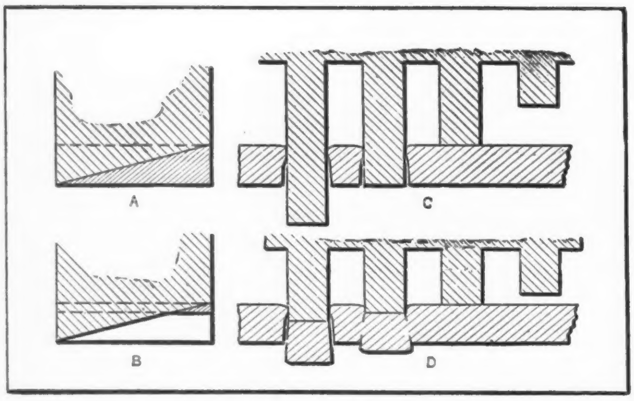


Fig. 15. (A and B) Diagrams Representing Full Shear; (C and D) Methods of Distributing Load in Multiple Punching Operations

metal. This is supposed to reduce the maximum area in shear, at any one time, to half the total area, and thereby to reduce the total load to half of the theoretical maximum. This may be nearly true for some unusual cases and materials, but for example, for mild steel (requiring a penetration to effect shearing of about a quarter of the metal thickness, and with proper clearance in the dies), the load rises to a peak and then falls to practically nothing in a quarter of the stock thickness. Then the "full shear" condition is better indicated at *B*, and the total load at any instant would be less than one-eighth of the pressure required with no shear—that is, with a flat punch and die.

Load Distribution in Multiple Punching

In perforating work with a number of punches, each punch or group of punches is sometimes made shorter than the preceding punch or group by the thickness of the metal (as shown at *C* in Fig. 15) to obtain the effect of shear. A better condition is obtained by stepping the punches or groups of punches only by an amount equal to the penetration required to effect a clean fracture. Such a condition is illustrated at *D*, where the length variations are such that one punch finishes its work as the next begins. In either case, the load curve for the individual punch (with proper clearance) would be similar to that in Fig. 10 or card *A* in Fig. 11. Adding the individual punch curves would give very nearly a smooth curve for arrangement *D*, Fig. 15, but arrangement *C* would result in a series of jumps from peak load to no load and back to peak load. This, combined with spring in the press, would bring the punches down upon the metal with a snap which would certainly reduce their life materially.

This plan of varying the punch lengths not only reduces the peak working load from the total for all punches to that of the individual punch, or approximately so, but there is another distinct advantage, and sometimes a greater one: As a punch progresses through a sheet of metal from its surface to the point at which the fracture starts (see central diagram, Fig. 5) there is a squeezing or pinching action between the corners of the punch and die, tending to squeeze out or spread the surrounding metal in the sheet. The result of this is indicated by the buckling of the perforated sheet. It is also apparent when perforating or punching comparatively thick metal with a number of small-diameter punches placed close together, the tendency of this crowding action being to spread and break the punches. As soon as a punch has penetrated the sheet far enough to start the fracture, it ceases to crowd out the metal around it. Thus, for example, in perforating a brake drum, Fig. 16, an effort to punch the large center hole and the small holes around it simultaneously, with all punches ground to the same level, would result in excessive breakage of the small punches; however, if the small punches were ground shorter than the large one by an amount *A* equal to one-quarter or one-third the thickness of the metal (as required), there would be no possibility of the center punch crowding metal out against the small ones.

There are other cases, also, where the crowding out of metal in punching seriously affects the product, and must be taken into account. Thus, in punching a series of notches in one side of a straight and narrow strip, if the notches are punched one at a time, that side of the strip will be so badly stretched as to bend the whole strip considerably. The way to accomplish the operation is to reinforce the punches to stand any crowding that may occur, and punch all the notches at once.

Again in such progressive operations as perforating and parting strip material in making chain links, the center distance between the holes must be very accurately maintained. There is a marked tendency in punching a hole approaching the width of a strip to stretch the strip lengthwise and also to crowd out the metal. One method employed to overcome the resultant inaccuracy is to perforate and part the link complete, and then shave a little metal out of both holes in one operation to make them round and accurately spaced. If the outside of the link must also be accurate, that must be shaved as well.

Stripping Load in Blanking

The stripping load in blanking is often very severe. A certain amount of it cannot be avoided, but when it becomes a menace to slender punches, for example, the means of minimizing it should be examined. First, to account for resistance to stripping, examine Fig. 5. As the punch penetrates the metal, it bends down, squeezes, and stretches the

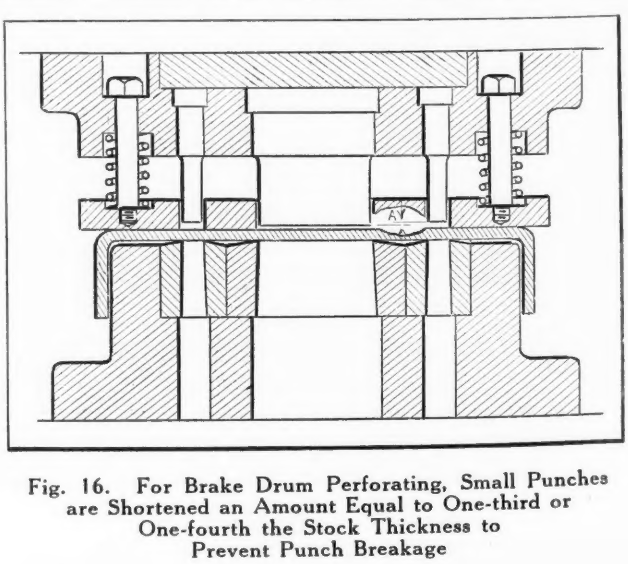


Fig. 16. For Brake Drum Perforating, Small Punches are Shortened an Amount Equal to One-third or One-fourth the Stock Thickness to Prevent Punch Breakage

surface strata until the fracture starts. When the fracture does occur, it releases the tensile strain in this strata (and in the others to lesser extent as they approach the center). The result is a tendency, due to elasticity of the metal, to spring back somewhat or to shorten in the long direction and to thicken up in the normal direction. At the fractured edge of the top strata this tends to make the hole smaller; consequently on the up stroke of the punch the metal tends to compress the fractured edge of the top strata around the punch. Clearly, any roughness on the surface of the punch, or a slight shoulder or tool mark around the punch, would add to the existing frictional resistance. Note also that the natural tendency of steel to "pick up" on steel, due perhaps to chance similarity in crystal structure and orientation, is enhanced, in stripping, by pulling the punch back against the pinched and roughly fractured edge of the hole.

There is also a tendency in the surface strata of the disk punched out to expand at the edge as the fracture releases the tensile stress. This tends to increase the diameter of the disk at this point and creates a resistance to pushing the disk through the die, for which reason the die is tapered larger at a slight angle (say about 2 degrees) from a short distance below the surface. The fact that the resistance to pushing the slug through the die is not so great as the stripping resistance is clearly due to the relative direction of motion with reference to the fractured edge.

Dullness of Cutting Edges

Dullness of the cutting edges is of interest as regards burrs and increased load and power requirement. Note in Fig. 5 that sharp cutting edges must localize and intensify the stresses that cause the fracture to start. Thus the tensile stress in the surface strata will be much more severe over a sharp corner than over a rounded or dull corner, at any point in the progress of the punch. Again, the pinching effect or compressive stress between the cutting edges of the punch and die is more highly localized, and hence more intense, between sharp edges than between rounded ones, at the same point of progress. Then, if the edges of the punch and die are dull or rounded over, the punch must penetrate farther to cause a fracture to start, increasing the load duration and hence the power required. Also, the compressive stress is spread both ways over a larger area, increasing the crowding effect and also the peak load.

The burr left by a dull edge is merely due to the fact that the metal, as it is pulled down to the point of fracture, follows the shape of the edge. The fracture starts, not from the center of the radius on a dull edge, but from the point where that radius joins the outside surface of the punch or the inside surface of the die. Thus if a punch face is flat, with a square edge, the edge of the punching is flat and fractures at that square edge. If the edge is rounded (dull), a burr remaining on the punching fits this radius very closely.

This may be made use of in some special cases where it is desired to dish or form the edges slightly while punching. If the punch face or the die is shaped as desired, the metal will follow that shape closely as it is drawn during the portion of the stroke that the punch is penetrating to effect shearing. Applications of this principle are not common except in a general way in hot work and in drawing and pinching-off paper shells.

Single-edge Shearing

Single-edge shearing, as in squaring shears and bar shears, requires little additional comment. Harder metal will require less clearance and will shear squarer on the edge than softer material. An unsupported portion of a bar or sheet will bend away from the blade (changing the relative angle of the fracture) during the penetrating portion of the shearing stroke before fracture occurs. Rake, or beveling the blade back from the edge instead of grinding it square, tends to reduce this somewhat. An unrestrained bar or sheet will move away from the cutting line of the blades in shearing due to the pinching action between the edges. This tends to give a cleaner fracture, but in soft metal, causes some change in the angle of the burnished portion of the edge relative to the surface of the metal. Shear on either blade, as in punching, shapes the metal in contact with it. Thus in shearing a long narrow strip from the edge of a sheet of metal, with the shear blade set at a considerable angle, the strip will be badly distorted by the progressive bending action of the blade as it is sheared off. The angle of shear should be based upon the depth of penetration rather than upon the total metal thickness, as discussed with reference to diagram *B* in Fig. 15.

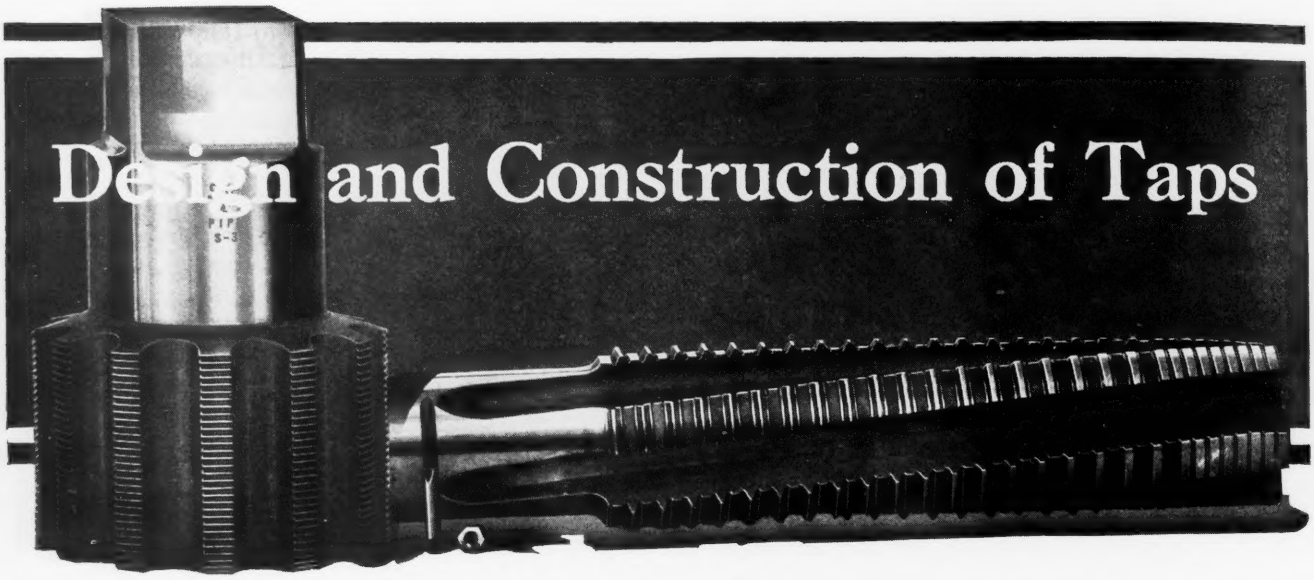
Care in press selection for blanking work, especially for quantity production or work requiring expensive dies, cannot be over emphasized, but it is a subject by itself and outside the scope of the present article.

* * *

PAINT THAT SEALS JOINTS AGAINST LEAKS

A paint that is said to be the only material that effectively seals joints against oil leaks has been developed by the General Electric Co., Schenectady, N. Y. The product, known as G-E No. 880 red protective paint, also prevents water and gas leaks. It can be used for many purposes that require red lead or white lead, and is less expensive than either. The paint, which is dark red in color, requires no priming and can be applied by brushing or dipping. Denatured alcohol is used as a thinner. It dries rapidly, and produces a hard, smooth, glossy film, which is easily cleaned and prevents excessive collection of dirt and conducting material, thereby decreasing surface leakage and subsequent carbonization of the surface when used with electrical apparatus.

One of the first fields in which the paint has been applied is in the manufacture of fuel oil burners, in which one company is now using the material to seal all joints. Other fields in which there will be applications for the paint include plumbing, chemical plants, repair and service shops, packing houses, shipyards, central stations, electric railways, mines, and the manufacture of oil tanks, oil-burning locomotives, and similar equipment.



Design and Construction of Taps

With Special Reference to Taps Having Ground Threads—Second of a Series of Articles

By A. L. VALENTINE, Manager, Tap and Gage Division, S K F Industries, Gothenburg, Sweden

IN the first article of this series, published in April MACHINERY, inaccuracies frequently found in taps not ground in the thread after hardening were analyzed and illustrated by numerous diagrams. The present article will deal with the reasons for the development of the ground tap, and proceed with some of the important considerations in the design and construction of taps.

Why the Ground Tap has Become Necessary for Accuracy

A study of the faults frequently found in taps that are not ground in the thread, as explained in the previous installment of this series of articles, will show that often the work supposed to be done by all the cutting teeth of the tap is done only by a few teeth; in consequence, the tap wears out more rapidly than if the work had been evenly distributed between all the cutting teeth. It is also evident that taps not finished in the thread after hardening have more serious faults than would be realized by one who has not thoroughly analyzed the subject. If these faults of taps and the fits between the resulting nut threads and the screw could be actually seen—especially the poor contact surfaces between the sides of the thread in the screw and nut—the author believes that taps finished in the thread after hardening would be employed to a much greater extent than they are at present.

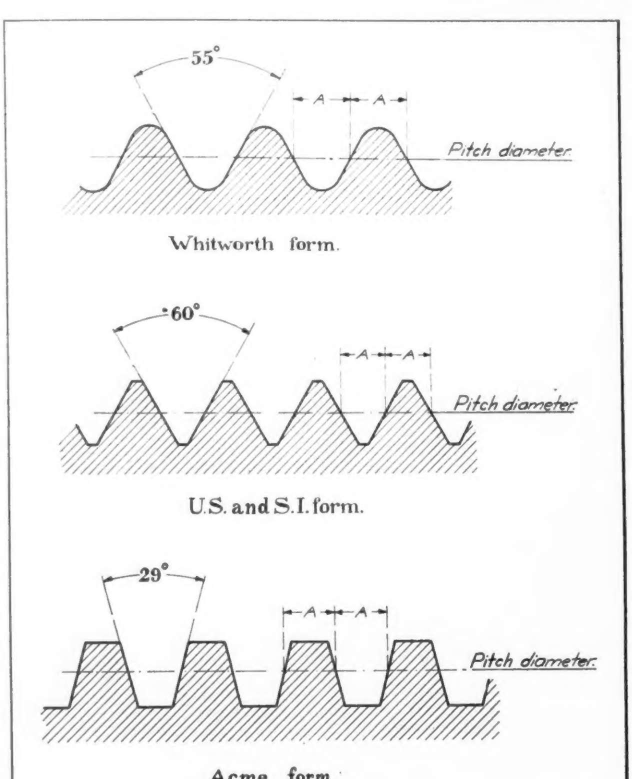


Fig. 1. Diagrams Illustrating the Meaning of the Term Pitch Diameter for Different Forms of Threads

When the fits between the threaded parts are such as have been described, it is no wonder that the threads in screws and nuts quickly wear out, that nuts shake loose and are lost, that the movement of screw-actuated slides is sluggish and requires a great deal of power, and that the movements of measuring and gaging members are frequently inaccurate. It is, therefore, only natural that manufacturers of automobiles, airplanes, machine tools, measuring instruments, and all machinery and tools subjected to shocks and vibration should urge the development of taps which, like all other cutting tools, should be ground after hardening in their most essential detail—the threaded cutting part.

Why the Development of Ground Taps was Slow

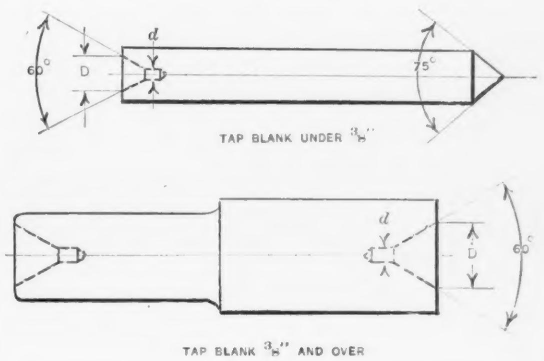
Many firms, especially in the United States, thoroughly studied the problem of grinding taps in the threads on a commercial basis as early as 1915, but it is only within the last four or five years that it has been possible to produce taps ground in the thread after hardening on a commercial basis and at a reasonable price. The delay in this development was due chiefly to the high cost of special thread grinding machines and the slowness of the thread grinding operation itself; also, of course, to the long time taken in experiments and in the solution of the

technical difficulties of producing proper thread grinding wheels and constructing thoroughly reliable, simple, practical, and not too costly machines for the thread grinding operation.

It should not be overlooked that male thread gages and precision screws have been successfully ground in the threads for many years. Such threaded parts, however, present quite a simple thread grinding problem, compared with that of grinding taps having different numbers of lands, different amounts of relief, and sometimes, perhaps, spiral flutes, which have come to be considered essential for many purposes by leading authorities. It is evident that the grinding of taps with spiral flutes and with relief in the threads necessitates thread grinding machines of an entirely different construction from those required for grinding taps with straight flutes, even though relieved in the thread. Such machines also have more complicated movements.

There are a number of thread grinding machines for grinding the threads of such parts as thread gages, screws, and even taps with straight flutes. Most American tap-making firms are now manufacturing ground taps, but to the best of the writer's knowledge, only one firm in the United States and one in Europe have so far solved the problem of producing spiral-fluted taps ground and relieved in the thread after hardening. As the latter taps differ in many essential points from the straight-fluted ground taps of both American and European manufacture, a comparison between the two types will be made later in this series of articles. Before dealing with the problems of tap design, however, the essential elements of the screw thread and its functions, and the importance of lead and pitch diameter will be briefly reviewed.

Dimensions of Centers in Taps



Centers in All Taps Except Pipe Taps

Tap Diameter in Inches	Tap Diameter in Millimeters	D	d	Tap Diameter in Inches	Tap Diameter in Millimeters	D	d
1/4	6	0.100	1/16	15/16	24	0.190	0.082
9/32	7	0.100	1/16	1	25	0.200	0.082
5/16	8	0.100	1/16	1 1/8	28	0.200	0.082
11/32	9	0.100	1/16	1 1/4	30	0.210	3/32
3/8		0.120	1/16	1 3/8	36	0.210	3/32
13/32	10	0.120	1/16	1 1/2	38	0.220	3/32
7/16	11	0.120	1/16	1 5/8	42	0.240	3/32
15/32	12	0.120	1/16	1 3/4	45	0.260	3/32
1/2	13	0.130	0.082	1 7/8	48	0.280	3/32
9/16	14	0.150	0.082	2	52	0.290	1/8
	15	0.150	0.082	2 1/4	56	0.290	1/8
5/8	16	0.160	0.082	2 1/2	64	0.290	1/8
11/16	17	0.160	0.082	2 3/4	72	0.350	5/32
	18	0.160	0.082	3		0.350	5/32
3/4	19	0.170	0.082	3 1/4	80	0.380	5/32
	20	0.170	0.082	3 1/2		0.380	5/32
13/16	21	0.170	0.082	3 3/4		0.400	5/32
7/8	22	0.190	0.082	4		0.400	5/32

Centers in Pipe Taps

Nominal Pipe Diameter in Inches	D	d	Nominal Pipe Diameter in Inches	D	d
1/8	0.120	1/16	1 7/8	0.290	1/8
1/4	0.130	0.082	2	0.290	1/8
3/8	0.160	0.082	2 1/8	0.290	1/8
1/2	0.170	0.082	2 1/4	0.350	5/32
5/8	0.190	0.082	2 3/8	0.350	5/32
3/4	0.200	0.082	2 1/2	0.350	5/32
7/8	0.200	0.082	2 5/8	0.350	5/32
1	0.210	3/32	2 3/4	0.380	5/32
1 1/8	0.220	3/32	2 7/8	0.380	5/32
1 1/4	0.240	3/32	3	0.380	5/32
1 3/8	0.260	3/32	3 1/4	0.400	5/32
1 1/2	0.280	3/32	3 1/2	0.400	5/32
1 5/8	0.290	1/8	3 3/4	0.420	3/16
1 3/4	0.290	1/8	4	0.420	3/16

The Screw Thread and its Functions

A screw thread has three principal functions: (1) To transmit power; (2) to transmit motion; and (3) (the most common) to hold two or more pieces together. As mentioned in the previous installment, the threads in a screw and its nut must fit each other so that when the two are screwed together a sufficient number of thread surfaces are in contact to prevent the nut from shaking loose from the screw. To obtain this necessary contact surface between the threads, it is imperative that the thread form be correct and that the lead, even if wrong, be at least the *same* in both the screw and the nut. On the other hand, it is not necessary that the pitch diameter be exactly the same in the two members, although it must be correct within certain limits.

If a screw with correct lead is screwed into a threaded hole, also of correct lead, it will be found, upon examination, that one side of all the threads for the whole length of the nut will be in contact with the opposite side of the corresponding threads in the screw, and if the screw were screwed up tightly against a fixed abutment, a certain amount of play would be apparent between the opposite sides of all the threads. The less this play is, the better is the fit between the screw and the nut, and the longer the life and the better the wearing quality of the two members. As to the strength and holding power, however, the contact surface between the threads in the screw and the nut need only be large enough so that the tensile strength of the threads is equal to the tensile strength of the core of the screw—that is, the area determined by its smallest or root diameter.

Tests have proved that less than two-thirds, or 66 per cent, of contact on one side of the thread between the screw and the nut threads (provided both have correct, or at least the same, lead) is sufficient, and this amount of contact is enough to prevent the stripping of the threads. This contact is also sufficient to prevent the nut from working loose, even when subjected to severe shocks and vibration. These statements are made to emphasize the extreme importance of correct or the same lead in screw and nut threads; if the lead is not correct, the diameter dimensions and the tolerances specified for these dimensions (which are sometimes entirely too small) are wholly without value.

Importance of Correct Centers in Taps

As ground taps usually rotate on their own centers during all operations in their manufacture and especially while being ground, carefully made centers are of great importance. Contrary to common practice, the size of the centers must not be determined in relation to the diameter of the stock or tap blank, but in relation to the diameter across the bottom of the flutes; otherwise, they are likely to be too large and too deep, producing thin and weak sections in the tap, and causing unnecessary strains during the hardening operation, which often result in hardening cracks.

On the other hand, the centers must not be too small, chiefly because in that case sufficiently large cuts cannot be taken during the various operations in making the tap. The small cylindrical hole must be deep enough so that in case the conical part of the center hole wears, a sharp center will not bottom. However, if the cylindrical hole is deeper than necessary, it may cause hardening cracks.

The accompanying table gives all the essential dimensions for center holes in taps. These dimensions have proved their value in practice. As it is difficult and expensive to produce sufficiently small center holes in taps of small dimensions, and as these centers would in any case be too small to give the necessary support when machining, taps from 1/8 to 3/8 inch are made with a 75-degree point at the threaded end, as shown in the illustration accompanying the table, and taps smaller than 1/8 inch, with 75-degree points at both ends.

It is of great importance that the tapered part of the center hole be round. If not, the tap will not be round and the ground relief in the threads will be incorrect. As taps are made from the smallest possible diameter of stock, it is also important that the centers come very accurately in the center of the stock, so that all the decarburized surface may be removed all around the outer surface of the tap blank.

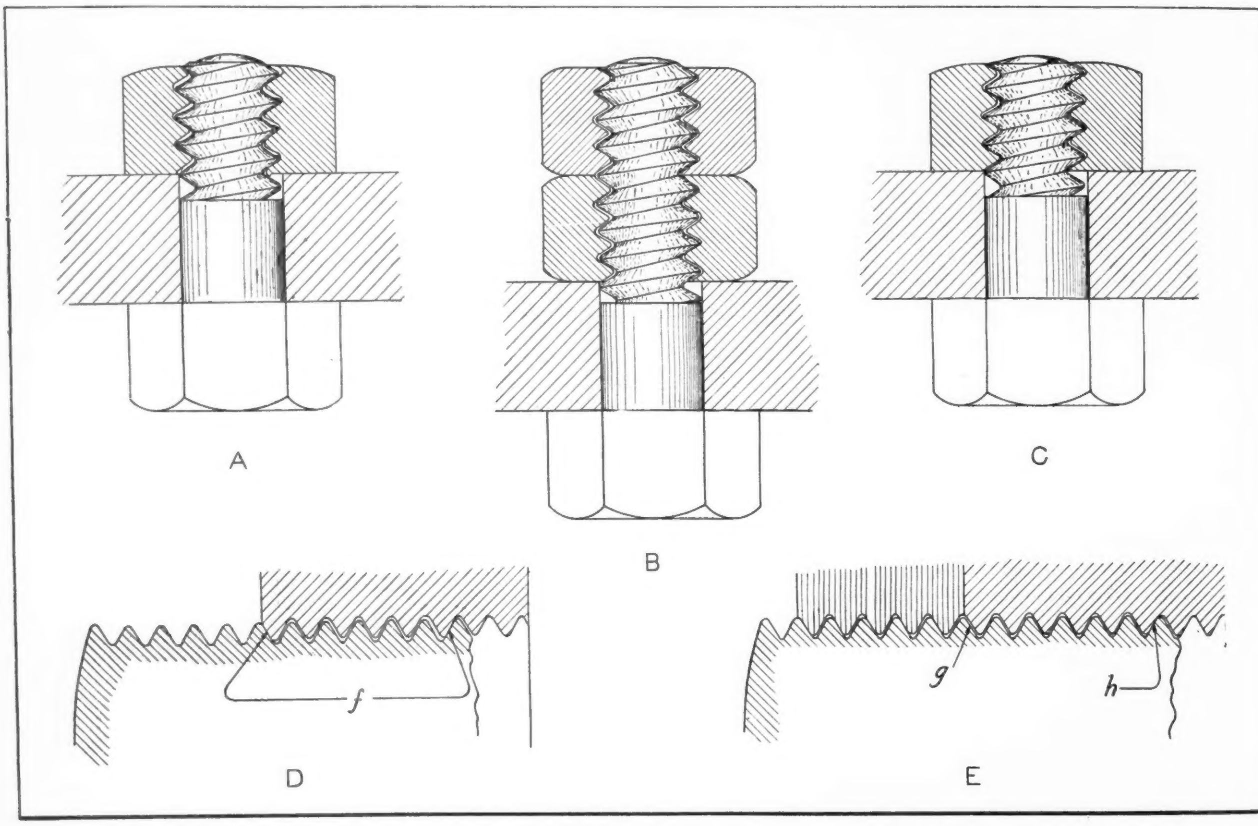


Fig. 2. Illustrations Showing Effect of Different Relations Between Lead in Screws and Lead in Nuts

If the blanks are turned on an automatic machine where the centering is done simultaneously with or after the turning operation, it is equally important that the bars be straight and that they be held in a straight position during the turning operation. Flat and hollow spots on the bars, of course, are also objectionable. If faults such as these are not guarded against, it is very likely that the taps will not harden properly on certain portions, and hence, will give unsatisfactory service.

The Lead and the Pitch Diameter

The author defines the pitch diameter of a screw, thread gage, or tap as the diameter at that point of the thread where the thickness of the tooth is equal to the width of the thread space, as indicated in Fig. 1. Errors in lead cannot be intelligently discussed without considering a certain length of thread in which the error occurs. As explained in the previous installment of this series of articles,

if the lead is correct, the pitch diameter may also be of the correct nominal diameter; but when there is an error in the lead, the pitch diameter must be increased a certain amount, depending upon the lead error.

The various combinations of errors in lead, pitch diameter, and form of thread were thoroughly covered in the previous installment. Suffice it, therefore, here to once more emphasize the fact that if a screw must be forced through a hole on account of an error in lead in either one or both members, the thread surfaces in contact at one end, so to speak, oppose in their action the thread surfaces in contact at the other end.

In Fig. 2 are shown a number of different conditions; the diagram at *C* indicates the contact when the lead is the same in both screw and nut, and the diagrams at *A*, *B*, *D*, and *E*, show conditions that are met with when there are differences and inaccuracies in the lead. It is evident that when the contact between the nut and the screw is as unsatisfactory as shown, the nut is likely to work loose.

The illustration *A*, Fig. 2, shows the deformation of the thread when the screw and the nut have different leads and the nut is forced on the screw. At *B* is shown a case where the lead is different in both the screw, the regular nut, and the lock-nut, indicating the few points where the threads are actually in contact. At *D* is shown a case where the threaded hole has a wrong lead; here only two thread sides are in contact, as indicated at *f*. At *E* is shown a threaded hole with incorrect lead, a lock-nut with correct lead, and a screw with correct lead. The result of the incorrect lead in the threaded hole is that when the nut is tightened there is no contact from point *g* until the last thread at *h* is reached, the latter being the only thread surface in contact in the threaded hole.

Over-size Dimensions and Tolerances on Ground Taps

Much data has already been published and a standard has been adopted by American tap and die manufacturers covering the lead error permitted and the tolerances on the diameter to be used on ground taps. There is no need, therefore, to repeat these figures here, except to state that the tolerance on lead has been fixed at plus or minus 0.0005 inch in a length of 1 inch. While most materials used for nuts and screws will probably stand being deformed to this extent, and will yield without serious results, this tolerance seems large with the present perfected machinery for grinding the threads in taps.

In contrast with this, it may be of interest to note that at least one American and one European manufacturer in their advertising literature guarantee a lead error not to exceed plus or minus 0.0001 inch in a length of 1 inch, for all types and sizes of ground taps. Compared with most American makes of taps, the tolerances on the diameter maintained by the European manufacturer referred to are also kept much closer—in fact, unnecessarily close.

The over-size on the diameter should be different for different types of taps and greater for taps of larger diameter, as indicated by the diagram Fig. 3. Nut and tapper taps, for example, should be made a greater amount over size than hand taps. A hand tap, as the name implies, is used mainly by hand and when accuracy is required, and is neither intended as a production tool nor as a tool to be used at high speeds. Hand taps are, therefore, made a comparatively small amount over size, which, however, should be determined with relation to the amount of relief on the tap, so that the longest possible wear and length of life may be obtained. On the other hand, nut or tapper taps, which are generally used in machines at high speeds, are mostly employed for quantity production of nuts, where, at least in as far as the diameter is concerned, no extreme precision is necessary. The diagram shown in Fig. 3 is based upon one employed by the European manufacturer of ground taps mentioned.

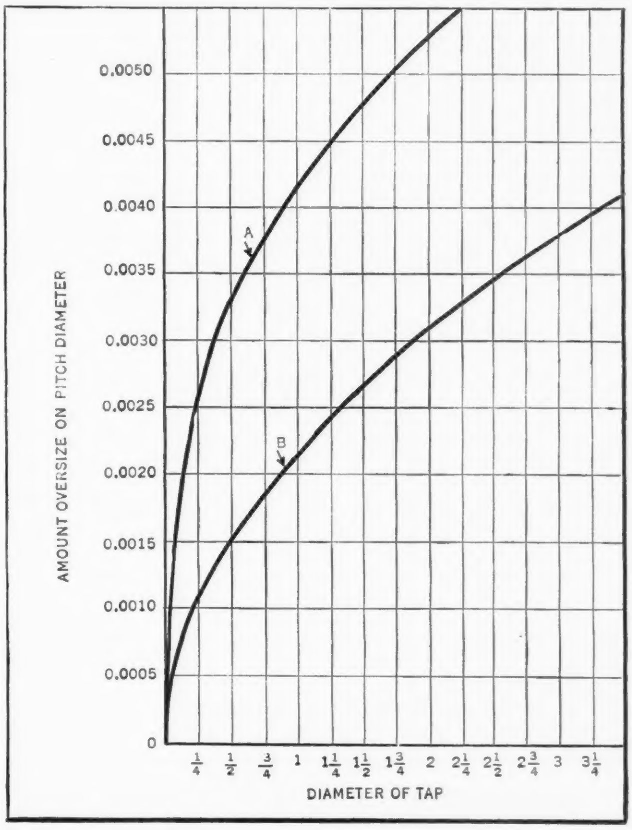


Fig. 3. Chart for Determining Amount of Over-Size on the Pitch Diameter in (A) Nut and Tapper Taps, and (B) Hand Taps and Straight Whitworth Pipe Taps

As an example of the small tolerances or limits employed, the following are quoted. On hand taps and straight pipe taps, these limits on the pitch diameter are + 0.0003 and — 0.0001 inch. The outside diameter is required to be within the limits of 0.000 and — 0.0008 inch. On nut and tapper taps the tolerances on the pitch diameter are between limits of + 0.0006 inch and — 0.0002 inch.

In the past the prevalent method was to have several tolerance classes for each type of tap. There may be a reason for this on unground taps, because of the many elements of uncertainty in their manufacture, but when taps are ground, there is no reason why the tolerances should not be the same for all sizes of taps if the thread grinding machines used are reliable.

Another reason for tolerance classes would, of course, be that the screws that are to fit the threaded holes have themselves such large tolerances that, in order to use them, tapped holes of correspondingly large tolerances are required. One European manufacturer of ground taps who uses a number of tolerance classes for different sizes of taps makes the taps in the smallest tolerance class so extremely little over size that a screw of exact nominal diameter will not pass through the tapped hole unless it has an absolutely perfect lead, which is hardly ever possible. Furthermore, if such a tap is used, for example, for tapping cast iron, and oil is used, as is often the case, for a lubricant, it will not tap half a dozen holes before it will become under size.

While ground taps should not be divided into tolerance classes, the taps should be a certain amount over size in pitch and outside diameter, and this amount should be determined in relation to the diameter and lead of the tap; but one of the greatest advantages of a ground tap is that instead of having to overcome its faults by establishing tolerance classes, as must be done with unground taps, the errors are eliminated.

Referring to Fig. 3, the curves there shown are for determining the over-size required on the pitch diameter. Curve A, for nut and tapper taps, gives the over-size dimensions required according to the formula

$$0.0042 \sqrt[3]{D} \text{ inch}$$

where D equals nominal diameter of tap in inches.

Curve B is for hand taps and for straight Whitworth pipe taps. The formula here used to obtain the amount of over-size on the pitch diameter is

$$0.0022\sqrt{D} \text{ inch}$$

in which D equals the nominal diameter of the tap.

As the diagram shows, the over-size for nut and tapper taps is approximately twice as great as for hand taps. The over-size dimension on the outside diameter of hand taps is equal to twice the over-size dimension for the pitch diameter. The over-size dimension on the outside diameter of nut and tapper taps is equal to one and one-half times the over-size dimension for the pitch diameter. The over-size on the pitch and outside diameter of straight Whitworth pipe taps is equal to the corresponding over-size dimension for the outside diameter of hand taps of the same actual (not nominal) diameter.

* * *

LAMINATION DIES

In determining the type of die to be used for producing laminations employed in electrical equipment, thorough consideration must be given to several factors, including convenience of construction, convenience and cost of maintenance, and economy of production of the laminations to be made. The design, of course, depends also directly upon the production requirements and the design and thickness of the laminations to be made. All these factors have been taken into consideration in discussing the various types of dies used to produce laminations in the metal stamping department of a large electrical manufacturing firm, as described in the article "Dies for Producing Laminations," which will appear in June MACHINERY.

COMPUTING THE MOMENT OF INERTIA OF UNSYMMETRICAL SECTIONS

By ELMER LATSHAW

The conventional method of computing the moment of inertia and section modulus of unsymmetrical sections is laborious. It is often necessary to repeat calculations several times, with slight changes in the general dimensions, before the desired section is obtained. Without doubt, any method or formula that lessens the arithmetical work is welcome to those who must make computations of this sort. A simplified method of determining the moment of inertia of unsymmetrical sections will be given in the following. This method has the feature of not requiring the location of the center of gravity of the section.

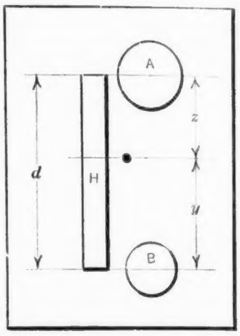


Fig. 1. Diagram for Finding Center of Gravity

The I-section, whether symmetrical or otherwise, resists flexure in an efficient manner, and for this reason, is popular for engineering structures. If it is symmetrical and made up of rectangular elements, its properties are easily found, but if the flanges are of unequal area or of a compound nature, the problem is difficult.

For deriving a formula applicable to the most general form of unsymmetrical I-sections, it will be assumed that in Fig. 1, A and B represent the areas of the flanges; H, the area of the web; y, the distance from the center of gravity of the lower flange to the center of gravity of the entire section; z, the distance from the center of gravity of the upper flange to the center of gravity of the entire section; and d, the center-to-center distance between the two flanges.

The total area T of the section $= A + B + H$. Then,

$$y = \frac{Ad + \dfrac{Hd}{2}}{T} = \frac{d}{T}\left(A + \frac{H}{2}\right) \quad (1)$$

$$z = \frac{Bd + \dfrac{Hd}{2}}{T} = \frac{d}{T}\left(B + \frac{H}{2}\right) \quad (2)$$

The moment of inertia of each of the three elements A, B, and H, about the center of gravity of the entire section, is found as follows:

$$I_1 = Az^2 + I_a = A\frac{d^2}{T^2}\left(B + \frac{H}{2}\right)^2 + I_a \quad (3)$$

$$I_2 = By^2 + I_b = B\frac{d^2}{T^2}\left(A + \frac{H}{2}\right)^2 + I_b \quad (4)$$

$$I_3 = H\left(\frac{y - z}{2}\right)^2 + I_h = H\frac{d^2}{T^2}\left(\frac{A - B}{2}\right)^2 + I_h \quad (5)$$

In these formulas, I_a, I_b, and I_h represent, respectively, the moment of inertia of each element about its own center of gravity.

Formulas (3), (4), and (5) are now added together to obtain the total moment of inertia I. Thus,

$$I = \frac{d^2}{T^2}\left[A\left(B+\frac{H}{2}\right)^2 + B\left(A+\frac{H}{2}\right)^2 + H\left(\frac{A-B}{2}\right)^2\right] + I_a + I_b + I_h \qquad (6)$$

Simplifying Formula (6),

$$I = \frac{d^2}{4}\left[(A+B) - \frac{(A-B)^2}{T}\right] + I_a + I_b + I_h \quad (7)$$

The values of the areas and moments of inertia used in Formula (7) can usually be read directly from tables. If the section being calculated should be symmetrical, the term $\frac{(A-B)^2}{T}$ would equal zero, and the formula would thus be further simplified.

It will be noted that it is not necessary to locate the center of gravity of the section to determine the moment of inertia from Formula (7). This is a feature that reduces the chances of error and saves time, although it is, of course, necessary to find the distance from the center of gravity to the most remote fiber in order to determine the section modulus.

The formula can be applied to a variety of sections which are special arrangements of the general I-section. Fig. 2 shows several such sections with the areas lettered to suit Formula (7). The reader may find other sections to which the formula may be applied.

To illustrate the application of the formula, the properties of the section shown in Fig. 3 will be calculated. In this example, $T = A + H + B = 10 + 16 + 6 = 32$ square inches. The first term of Formula (7)

$$\frac{d^2}{4}\left[(A+B) - \frac{(A-B)^2}{T}\right] = \frac{9^2}{4}\left[10 + 6 - \frac{(10-6)^2}{32}\right] = 313.9 \text{ inches}^4$$

$$I_a + I_b = 1.33 \text{ inches}^4$$

$$I_h = 85.34 \text{ inches}^4$$

By adding these three values together, it will be found that $I = 400.57$ inches^4.

To determine the section modulus, it is necessary to calculate the distance from the center of gravity to the most remote fiber. Substituting the proper values in Formula (1), it will be found that

$$y = \frac{9}{32}(10 + 8) = 5.0625 \text{ inches}$$

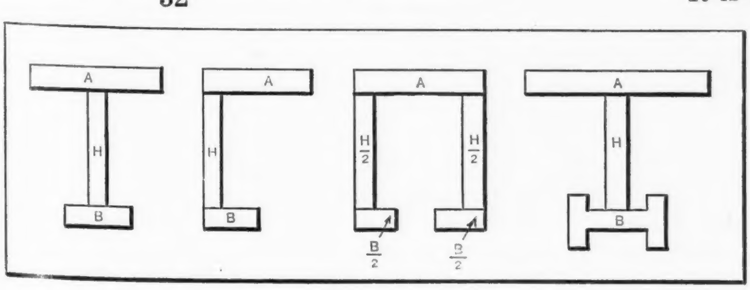


Fig. 2. Typical Unsymmetrical Sections to which Formula (7) may be Applied

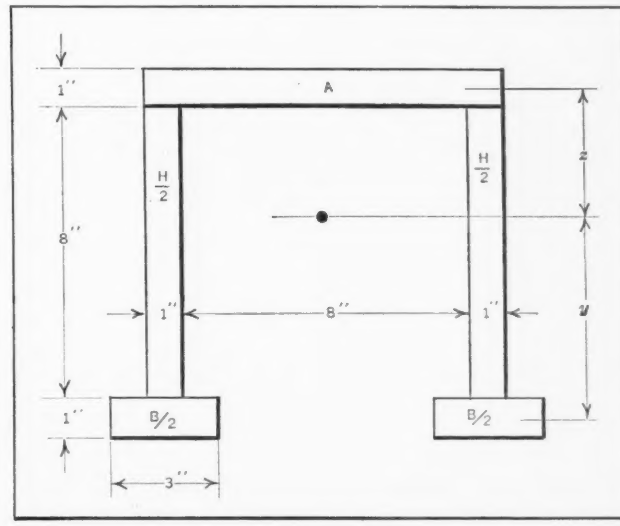


Fig. 3. Unsymmetrical Section, of which the Moment of Inertia and Section Modulus are Calculated

Adding to this distance one-half the thickness of the lower flange, gives 5.56 inches as the distance from the center of gravity to the most remote fiber. The section modulus is now found to equal $\frac{400.57}{5.56}$ or 72 inches^3.

* * *

THE VALUE OF MACHINE TOOL EXHIBITIONS

By J. P. GOODYEAR, General Superintendent, Robbins & Myers Co., Springfield, Ohio

It is our opinion that nowhere can the desired complete information relative to machine tools be so easily obtained as at a machine tool exhibition, and nowhere can the merits of different machines and tools be so thoroughly demonstrated as at such exhibits. The opportunity offered to actually see the equipment presents the best possible way for an analysis of its fitness on the particular production problems facing each shop executive.

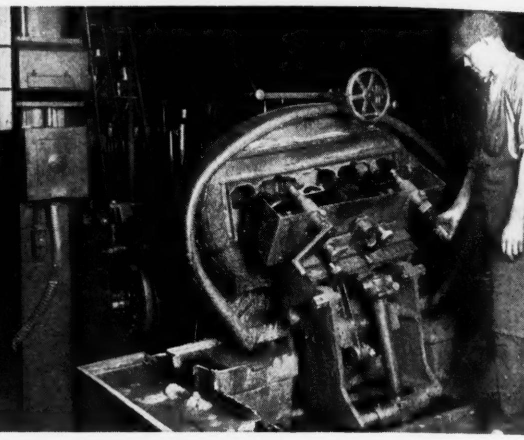
The company with which the writer is connected manufactures electric motors. At a recent machine tool exhibition we were particularly interested in studying machine tools that would help us in our effort to reduce costs and increase production. One particular machine that impressed us greatly was an armature notching press running at 700 strokes per minute. We had equipped presses in our own plant to run at one-half this speed and thought that the limit in speed had been reached. We are just now securing one of these machines for use in our plant.

It is not an exaggeration to say that a majority of the machine tools purchased since our visit to the last machine tool exhibition have been selected largely because of information obtained at that time.

* * *

Of the total imports of machine tools into Spain in 1925 (the last year for which complete figures are available), Germany supplied 41 per cent; Great Britain, 34 per cent; France, 11 per cent; and the United States, 5 per cent.

Surface Grinding Developments in Automotive Plants



Operations in which Predetermined Amounts of Stock are Ground from Parts in Osterholm Machines

By CHARLES O. HERB

MANY automotive and other parts have flat pads, bosses, or flanges which must be finished accurately or comparatively close to specified dimensions, and also parallel with other machined surfaces. It is for work of this general class that the Osterholm automatic surface grinding machine was primarily developed, although cylindrical grinding can also be performed on this machine when a special fixture is provided. Flat surfaces are often ground to nominal dimensions within 0.0005 inch. The machine is a product of Williams, White & Co., Moline, Ill.

Operating Principle of the Machine

Except for loading and unloading the fixture, the operation of the machine is entirely automatic. During loading, the table is inclined, as shown in the heading illustration. After the fixture has been loaded and a convenient lever moved to start the machine, the table swivels upward until the top is at right angles with the face of the grinding wheel. Simultaneously, the table starts oscillating to the right and to the left in front of the wheel, making nineteen oscillations per minute. The work is held in a fixture that is usually designed to suit each individual piece.

The grinding wheel is advanced toward the table by means of a cam a sufficient amount to grind the work to the required dimensions, and the wheel remains in the forward position long enough to cut itself free. Finally, the wheel retreats, the table ceases oscillating and drops into the inclined position, and the machine stops. The range of oscillation, and the position of the grinding wheel relative to the table, can be adjusted to suit the work. It is desirable that not more than 3/64 inch of stock be removed with the automatic feed to the grinding wheel; however, much larger amounts can be ground off by employing the hand feed. Surfaces up to 10 inches wide by 38 inches long can be finished.

Water is pumped copiously through the wheel-spindle and cascaded with force across the face of the wheel to prevent it from loading and the work from heating. A sheet metal guard in front of the wheel protects the operator from the water. Holes of a size and contour to receive the surfaces of the work to be ground are cut in this guard, as may be seen from the heading illustration. In most work-holding fixtures designed for use on this machine, a wheel dresser is incorporated in the fixture.

Grinding Tractor Parts

In one plant of the International Harvester Co., machines of this type are equipped with the fixtures illustrated in Figs. 1, 2, and 3. Fig. 1 shows two fixtures employed in grinding both sides of the lower member of a radiator frame. The part is an iron casting. Use is made of the fixture shown at *X* for grinding the joint face, this operation being accomplished in an average floor-to-floor time of 1 minute 30 seconds. Two cams of the type shown at *A* and *F* are used to force the piece down and to the right against stops. These cam clamps are held firmly in contact with the part by means of a bayonet locking arrangement. Screw *B* is advanced against the flange near the middle of the piece to support it. An adjustable grinding wheel dresser is mounted at *C*.

The fixture employed to hold the

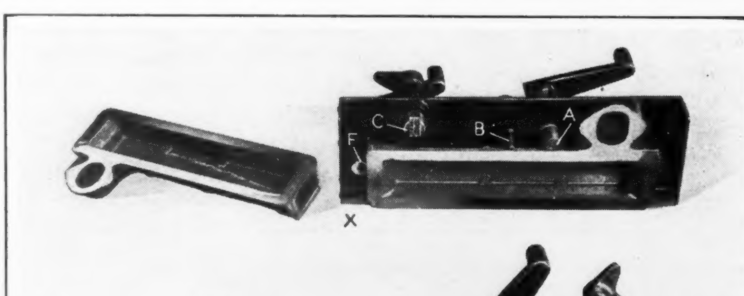


Fig. 1. Two Fixtures Employed in Grinding Both Sides of a Radiator Frame Casting

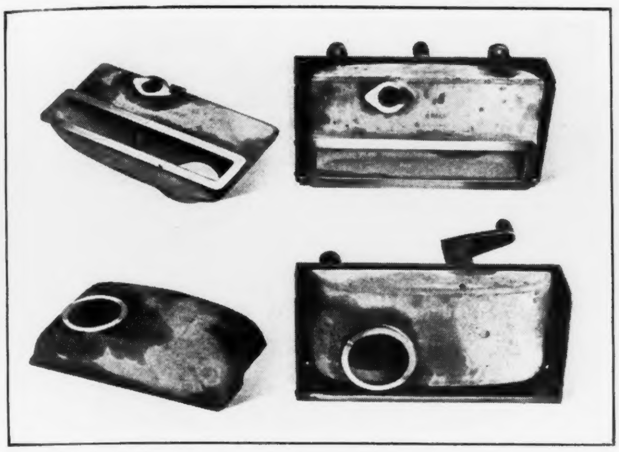


Fig. 2. Fixtures Employed in Grinding Surfaces on Two Sides of Another Radiator Frame Casting

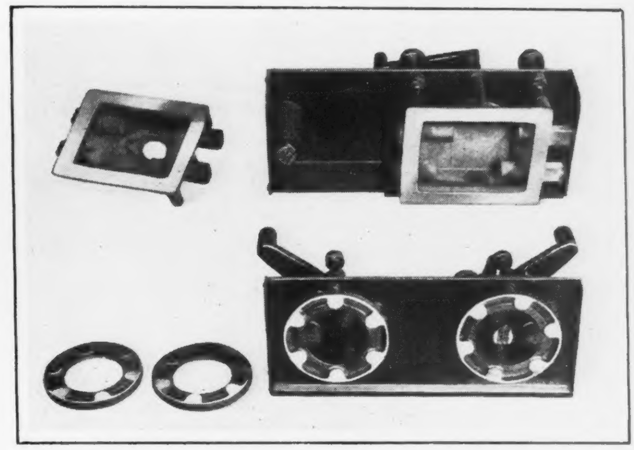


Fig. 3. Construction of Fixtures Employed in Grinding Transmission Case Covers and Wheel Washers

radiator base while the bottom is being ground is shown at *Y*. This fixture is also furnished with two cam clamps, one of which may be seen at *D*, for locking the part against stops. The grinding wheel dresser is located at *E*. In this operation on the part, the floor-to-floor time averages 1 minute.

Fixtures employed in grinding the top member of the radiator frame are illustrated in Fig. 2. This is an iron casting weighing approximately 30 pounds. The first operation consists of grinding the radiator joint face and the water connection boss, and is accomplished by means of the fixture shown in the upper half of the illustration. A cam clamp incorporated in the fixture operates on the filler cap ring, and two adjustable feeler screws are used to back up the casting on the ends. The floor-to-floor time per piece in this operation averages 1 minute 45 seconds.

The second operation on this part consists of grinding the filler-cap ring pad, and is performed in the fixture shown in the lower view, in a floor-to-floor time of 45 seconds. A cam clamp incorporated in this fixture is gripped on the radiator joint flange and the casting is also backed up by means of feeler screws.

The upper fixture shown in Fig. 3 is used for holding transmission case covers while grinding the joint flange. The casting is seated on V-blocks, and a cam clamp is tightened on a broad flat surface. This part is also an iron casting and the operation is finished in 1 minute 20 seconds.

Wheel washers are ground while held in the lower fixture of the illustration, two washers being ground at one time. Each washer is slipped over two stationary posts and an adjustable cam clamp, the clamp being tightened against the work to lock the piece in place. This operation is performed at the rate of two washers every minute.

Operations on Sleeve-Valve Engine Parts

Three parts ground on Osterholm machines for assembly into engines built by the Yellow Sleeve-Valve Engine Works, Inc., are shown in Fig. 4, together with the fixtures employed. Five pads of a cast-iron intake manifold for four-cylinder engines are ground while held in the fixture illustrated at *X*. The manifold is supported firmly by two special blocks *A* on which it is forced by means of cam clamps *B*. Fixed screw *C* backs up the casting in the middle of the upper edge. The grinding wheel dresser is located at *D*. In this operation, an average production of 75 manifolds per hour is maintained.

At *Y* is shown a fixture used in grinding an aluminum engine support bracket, this part being ground with the same wheel as is used in finishing the cast-iron manifold. The part is seated on the sloping sides of two blocks and held in place by means of the equalizer clamp *E*. This clamp is locked on the casting by means of a cam. As indicated at *F*, this fixture also contains a wheel dresser. A production of 100 pieces per hour is maintained in this operation.

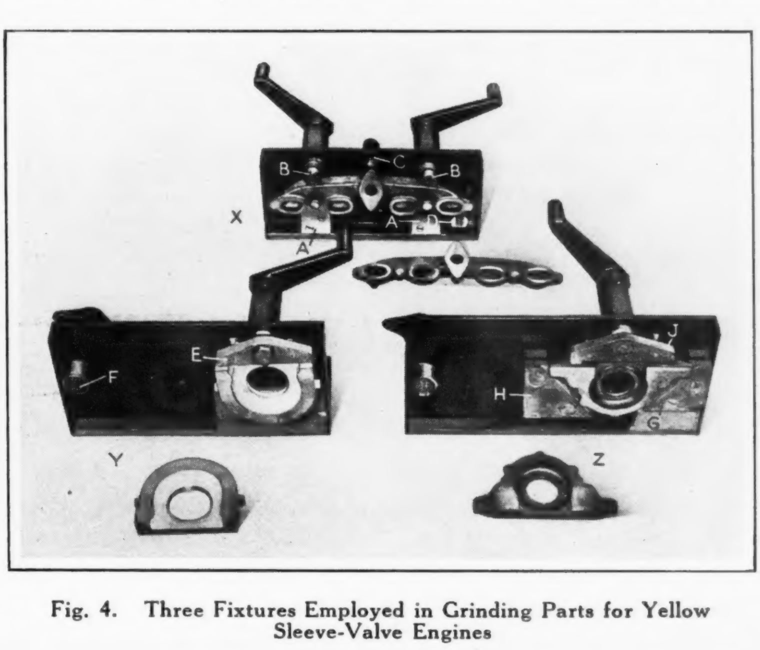


Fig. 4. Three Fixtures Employed in Grinding Parts for Yellow Sleeve-Valve Engines

A somewhat similar fixture design is shown at *Z*. On this fixture, however, while block *G* is stationary, block *H* is of an equalizing type. Clamp *J* is also of equalizing construction, and is locked on the work by means of a cam.

Finishing Rear-axle Housings and Transmission Cases

Two faces of Hupp pressed-steel rear-axle housings are ground by means of the equipment illustrated in

Fig. 5. One face is ground and then the housing is replaced in the fixture for grinding the opposite face. In each case, the housing is located from ground bearing supports. Approximately twenty housings are finished on both sides per hour.

Transmission cases for Essex automobile engines have the bell-housing flange ground in the machine illustrated in Figs. 6 and 7. These aluminum castings come to the machine after being finish-bored, and the requirement is that the bell-housing flange must leave the machine at a true right angle to the bore axis, within a tolerance of 0.005 inch. The parts are actually produced with the flange surface true within 0.003 inch.

In locating the casting in the fixture, one end of the finished bore is seated on the accurate plug *A* and then the front end of plug *B* is entered into the opposite end of the bore by moving handle *C*, which actuates a rack-and-pinion mechanism. This provision insures that the flange will be ground in the desired relation to the bore. The ears on the case are backed up by means of adjustable supports. In this operation, one transmission case is finished every minute. To assist in removing the casting from the fixture after an operation has been completed, an eccentric is provided within plug *B*. This eccentric is raised in back of a shoulder on the transmission case by means of the crank-handle in front of the plug *B*, with the result that the case is pulled from the plug *A* as the handle *C* is operated to withdraw plug *B*.

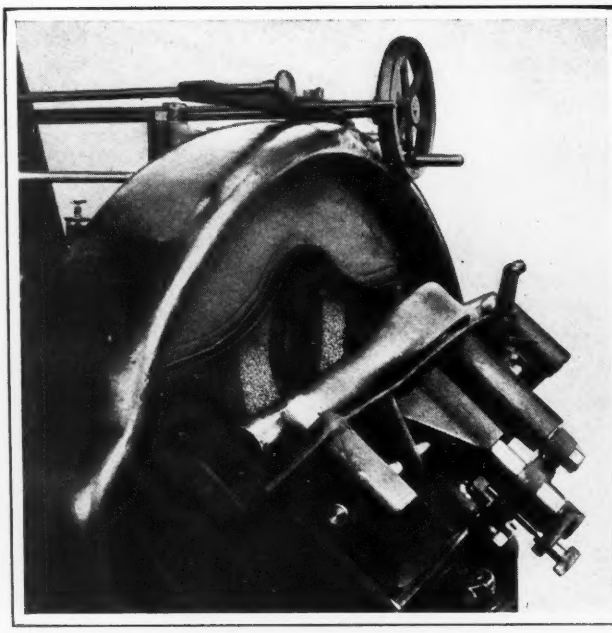


Fig. 5. Grinding a Pressed-steel Rear-axle Housing on Two Faces, One at a Time

The heading illustration shows an operation on eight-cylinder manifolds in the Packard plant. Five separate surfaces are finished, and the production averages fifty pieces per hour.

* * *

The New York State Department of Education offers twenty-five scholarships of $1000 each to men and women with the requisite trade and technical training who desire to engage in the teaching profession. Those who have been awarded these scholarships and who complete satisfactorily the prescribed one-year resident course in industrial teacher training at the State Normal School at Buffalo, N. Y., will receive a life license to teach their respective subjects in the public schools and institutions of the state. Salaries paid to vocational teachers in the public schools in the state of New York range from $1800 to $3500 a year. Those interested may obtain additional information by writing to the Division of Vocational and Extension Education, State Department of Education, Albany, N. Y. All applications must be filed on or before May 15.

* * *

The Society of Automotive Engineers has now 6000 members; over 75 per cent of these are located in ten states. Michigan leads with 1107 members; then follow New York, 1056; Ohio, 624; Pennsylvania, 420; Illinois, 361; California, 267; Indiana, 259; New Jersey, 242; Massachusetts, 207; and Wisconsin, 163.

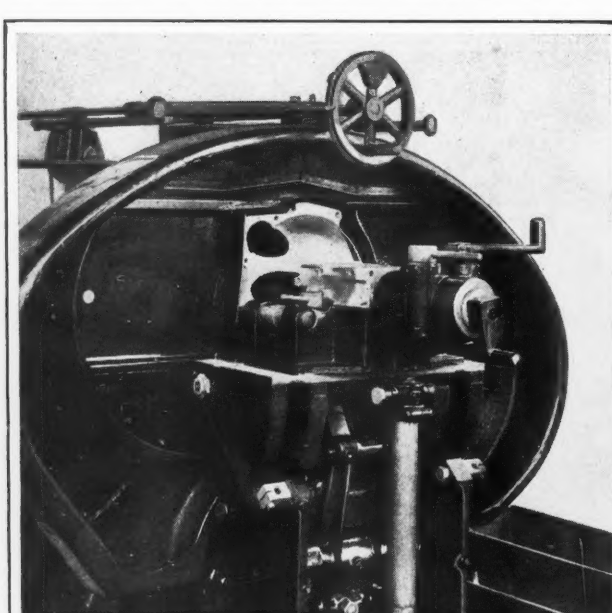


Fig. 6. Equipment Employed in Grinding the Bell-housing Flange of an Aluminum Transmission Case

Fig. 7. Equipment Shown in Fig. 6, with the Work Removed and the Table Inclined for Loading

The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, April 15, 1927

THE first quarter of this year has closed in what seems at first sight a disappointing manner, probably because there has not been any startling revival in any one branch of the metal-working industries. A closer investigation, however, reveals the fact that all branches are working steadily, many at full pressure, and that all are quietly confident of the future. The machine tool industry has probably found the least improvement, but it is a branch on which the effects of prosperity are always delayed. Most makers, however, seem to be working full time.

The fact that unemployment has decreased generally throughout the country is another encouraging sign, the figures having fallen steadily from 1,480,000 on January 1 to 1,170,000 at the end of February. The cost of living—that is, average retail prices—has also dropped from 74.7 to 72 per cent above 1914 prices in the same period.

The Machine Tool Industry has Fair Outlook

Although a satisfactory amount of work is passing through the shops of machine tool makers, it can hardly be said that the first quarter of the year has realized the hopes that were anticipated. There have been slight spurts and quiet spells, but provided the impending Budget does not place any further strain on industry, it is confidently expected that the machine tool industry will reap useful benefits during the rest of the year. A large proportion of machine tool makers' output still seems to be destined for abroad—always a healthy sign for the future.

Overseas Trade in Machine Tools Drops Slightly

The exported tonnage of machine tools dropped during February for an unaccountable reason to 841 tons, with a value of £104,109—approximately the same figure as in December. The ton value, however, rose from £113 in January to £117 in February. The imported tonnage also dropped from 525 tons to 385 tons, with a drop in value from £105,338 to £69,440, so that there is still a considerable favorable balance on the export side. The ton value of imported machines was £192. Since last November the ton value of imported machine tools has risen steadily, and is possibly a sign that British manufacturers have ceased to buy cheap foreign machines in preference to those made at home. If that is so, then there is great hope for the British machine tool industry.

The value of tools and cutters exported dropped slightly from £51,925 to £48,407. From the classified machine tool exports for February, lathes were the best sellers with £35,109. Drilling machines came next with £13,360, while milling machines rose well above the usual figures to £10,727. The Colonies, Japan, and the Argentine proved very good customers.

The Shipbuilding Industry is Busy

Shipbuilding yards are very well employed, and many of them have large arrears of work to make up, now that supplies of material are available. Night shifts have even been started in several yards, and local steel works are all going at full pressure. Another satisfactory sign is that repeat orders are frequently being placed now for motor ships of about 10,000 tonnage with North East Coast, Scottish, and Belfast shipbuilders.

Conditions in Railway Engineering Field are Good

For colonial and foreign railway business, competition from the Continent is severe, while home railway departments are buying sparingly at the moment. Car builders, however, have a good volume of work in hand, and considerable repair work is being undertaken. Rolling stock makers have been receiving good business from Egyptian and other foreign railways.

Electric railway engineers all have excellent orders on hand, a recent one, for example, being for the equipment and electrification of 334 miles of track for the Great India Peninsula Railway. This order is valued at £700,000.

Activity is Evidenced in the Automobile Industry

The automobile industry is generally very busy after a little quieter period, and makers of moderate priced cars have large programs ahead. The improvement is in heavy commercial vehicles as well as cars and motorcycles, one single contract for motor omnibuses for South America running into six figures. This increase in business is, of course, having beneficial effects on the machine tool and steel industries.

The exports of British motor vehicles now exceed the imports for the first time, an adverse balance of 20,000 vehicles in 1925 being converted into a favorable one of 10,000 in 1926. It is confidently expected to increase this number materially in 1927.

Iron and Steel and General Engineering Industries are Well Employed

The volume of new business in the iron and steel industries is still rather disappointing, but producers of all kinds are well employed, many having contracts that will keep them busy for the next six months. Buyers are clamoring persistently for a reduction in prices, but producers declare that they cannot materially reduce quotations until fuel is cheaper.

The call for constructional steel is improving, and new shipyard business will doubtless help the steel industry in a short time. More furnaces are in blast each month now, and if only a reduction could be made in prices of coke and pig iron, the iron and steel industry would undoubtedly receive a great impetus.

Current Editorial Comment

in the Machine-building and Kindred Industries

GOOD BUSINESS—NO RECORD BREAKERS

We have become so accustomed to measure business conditions by comparing the present level of activity with some record-breaking period of the past that we are likely to consider business unsatisfactory if it does not exceed, or at least equal, some previous peak. This is likely to set a false standard for measuring business conditions and to create disappointment with a volume of business that should be considered normal.

Instead of comparing with the peak, it would be much better to compare with the average of a number of years. Most business reviews pointed out that production fell off last December, and some forecast a drop for 1927 on that account. As a matter of fact, although December had the lowest production of the year in the basic industries, it was 5 per cent above the average monthly production of the three years 1924, 1925 and 1926.

We should accustom ourselves to the idea that business will not increase steadily month after month, or year after year; because any such expectation inevitably will bring disappointment. There cannot be peaks without intervening recessions; and we should remember that it is the average business over a period of years which counts. This average at present is high—a very encouraging fact to remember.

* * *

ILLUSIVE QUANTITY PRODUCTION

One of the difficult shop management problems is to decide on the most economical quantity of parts to produce at one set-up of a machine. Guessing will not decide this question accurately. It is necessary to take into account the savings possible by producing in large instead of small quantities, and to compare them with the cost of carrying the parts in stock until they are all used in the assembly of the product they are intended for.

The production man is usually eager to produce in as large quantities as possible because he sees only the saving due to quantity production; but ordinarily the cost of carrying parts in stock, including interest on the investment in material and labor, rent, insurance, and other overhead charges, amounts to about one per cent a month. Therefore, if by quantity production only ten per cent of the cost is saved, to produce one year's requirements at a time results in a loss rather than a saving.

In a plant recently visited, a saving of only 5 per cent was effected by producing in one lot sufficient stock for three years, while the cost of carrying the parts in stock until used was 36 per cent.

Considerable material and labor also is wasted in shops by producing too far ahead of actual needs, because many parts become obsolete before they are used. In almost every machine shop are quantities of parts that must be thrown away eventually, because of changes in the design of the machine or product they were originally intended for.

It pays to consider carefully all these points before deciding what quantity to produce at one set-up of machines and tools.

* * *

IMPROVEMENTS IN DIE-CASTINGS

The die-casting industry is making constant improvements in its methods and in the metals used for its products. Ten years ago the die-casting process was thought suitable only for comparatively small castings; but gradually their size has increased until now it is possible to successfully produce aluminum die-castings up to 10 pounds in weight, and zinc castings up to 25 pounds.

Along with this development has come a constant improvement in the metals used for die-castings. Recently we had an opportunity to inspect the records of tests made on an improved zinc-base die-casting metal, which had a tensile strength of from 48,000 to 50,000 pounds per square inch (in a test specimen 1/8 by 1/2 inch in size), with an elongation varying from 3.5 to 6.5 per cent. In addition, the test specimen proved to have a remarkable resistance to twisting strains; in a length of 2 inches it had been twisted about 240 degrees.

One of the limitations of die-castings in the past has been that they would wear rapidly when subjected to abrasion, because the die-casting metals are not so hard as steel. Even this disadvantage, it appears, is very likely to be overcome in the future. Chromium-plating is being experimented with for producing a hard wearing surface on the soft die-casting metal, and if this process can be applied to die-castings, there is no reason why they should not wear as well as casehardened steel. If the experiments now being made prove successful, new fields for die-castings will open up.

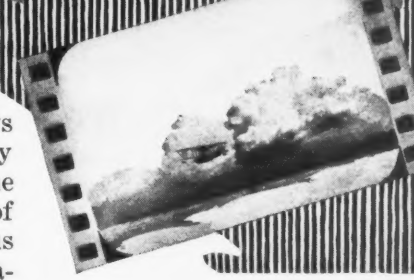
* * *

DON'T FORGET THE SLIDE-RULE

In many manufacturing plants, where every effort is made in the shops to save costs by reducing production time, a great deal of time is wasted in the drafting-rooms by making calculations in the ordinary arithmetical way instead of by using the slide-rule. Many calculations do not require accuracy to the last decimal, and in such cases the slide-rule provides a convenient means for obtaining results in a fraction of the time otherwise needed. The slide-rule should be considered a labor-saving tool whenever it can be applied, because it is just as inefficient to use old-fashioned methods of calculation when the slide-rule can be substituted as it is to do shop work by hand that should be done on a machine.

The Age of Speed

A Demonstration of the Possibility of Making an Industrial Motion Picture Entertaining as Well as Educational

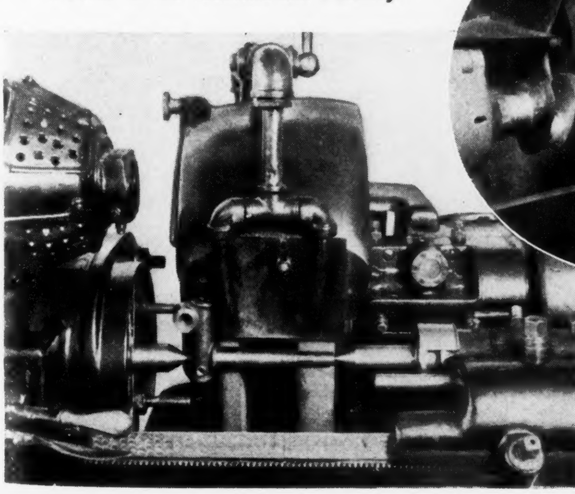


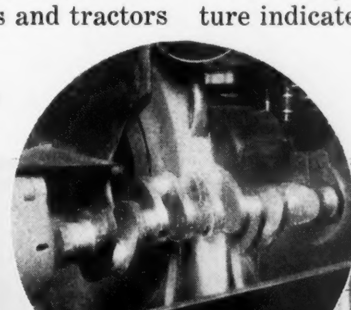
THE motion picture has on many occasions in recent years been made an excellent vehicle for an industrial message. The methods of great industries have been pictured in a manner highly instructive to men engaged in other fields of industrial endeavor. A fine example of the motion picture art applied to industrial work has recently been added to the long list of good productions of the past. "The Age of Speed"—a film recently completed by the Norton Co., of Worcester, Mass.—demonstrates in an interesting way how an industrial motion picture can be made entertaining as well as instructive.

Beginning with pleasing pictures of transportation in all its forms—from the Twentieth Century Limited, the airplane, and the speed boats that skim over the water's surface at more than a mile a minute, to the slower moving trucks and tractors—the film shows how closely connected is the performance of modern means of transportation and machinery with the art of grinding. In four reels of motion picture, the part grinding plays in many industries is illustrated. It becomes evident that it would be well nigh impossible to conceive of our modern means of transportation and our high-speed production machinery, were it not for the fact that the precision work required in their construction is made possible by the grinding machine and the grinding wheel.

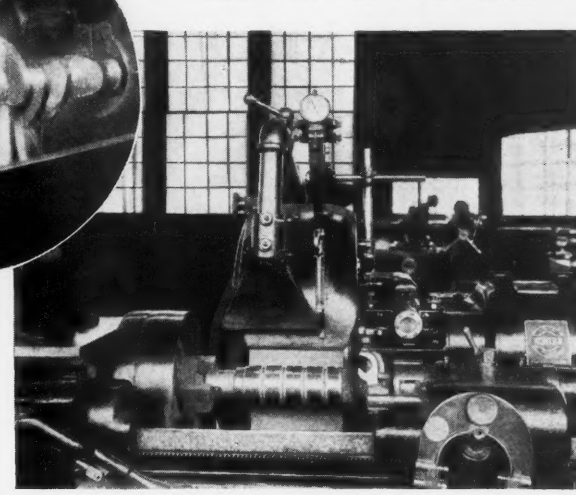
The story told by the captions of the motion picture indicates the scope of the picture and the con-

Grinding Steering Knuckles with Twin Wheels in an Automobile Factory

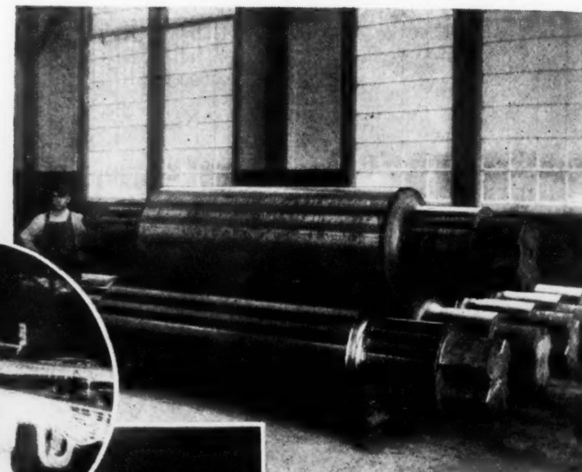


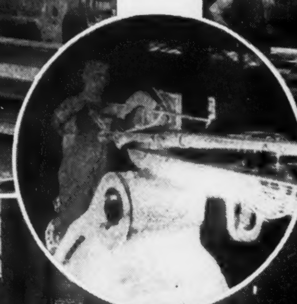


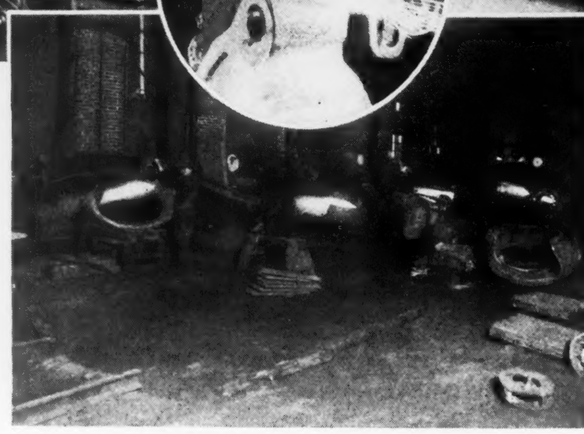
Grinding Several Ball Bearing Races at the Same Time with a Wide Wheel



The Grinding of the Large Rolls Used in Steel Mills Requires Unusually Heavy Grinding Equipment. The Immense Size of Some of These Rolls May be Judged from the Picture of Finished Rolls Shown in the Upper Right-hand Corner







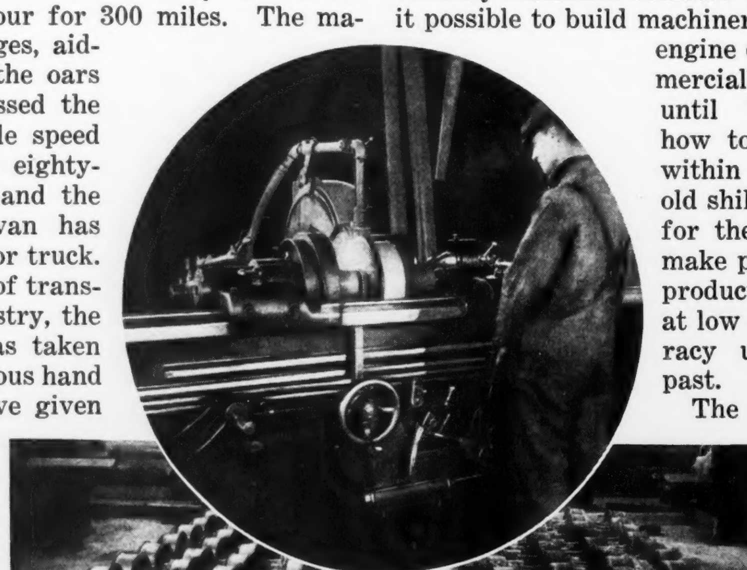
The Insert and the Picture to the Left Show the Snagging of Manganese Steel Castings with a Swing-frame Grinding Machine. This Material Cannot be Machined with Ordinary Cutting Tools, but Must be Finished with Abrasive Wheels

tinuity of the film. "This is the age of speed," we are told. We think nothing of being in New York in the afternoon and in Chicago, nearly a thousand miles away, the next morning. The "magic carpet" which transports us moves at a rate often exceeding a mile a minute. If we analyze our modern life, we find that it differs from that of other ages chiefly in the rate of motion—in speed. The airplane has achieved the almost incomprehensible speed of 246 miles per hour. Where the old Roman chariots may have attained twenty miles an hour for short distances, racing automobiles of today have averaged 100 miles an hour for 300 miles. The mariners of the early ages, aiding their sails with the oars of galley slaves, crossed the seas but slowly, while speed boats of today make eighty-two miles an hour; and the slowly moving caravan has given way to the motor truck.

Not only in means of transportation but in industry, the same speeding up has taken place. Primitive, tedious hand weaving methods have given place to the modern automatic loom, and the old-fashioned type-setter would gaze in astonishment at his mechanical descendants, the linotype and the monotype machines.

All that has been said is evident to whoever observes what is going on about him, but how many realize that all this modern development depends solely on the ability to manufacture mechanical devices in quantity with an extraordinary degree of perfection, and that among the processes used in this manufacturing work, grinding occupies a most important position?

Even if man had known of the possibilities of the steam engine or the internal combustion engine centuries ago, he would have been unable to avail himself of these power-producing mechanisms, because the means then available for producing accurately machined surfaces were too crude to make it possible to build machinery successfully. Watt's engine did not become a commercially practical appliance until Wilkinson discovered how to bore cylinders "true within the thickness of an old shilling"; and it remained for the grinding machine to make possible the commercial production of duplicate work at low cost and with an accuracy undreamed of in the past.



The Rollers on which the Panama Canal Gates Move are Made from Manganese Steel. They were Ground at the Norton Plant

The automobile industry is one of the outstanding examples of the numerous applications of grinding. It is stated that for every high-grade automobile built, four dollars' worth of grinding wheels are used up; and even in the cheapest cars about a dollar's worth of wheel is consumed.

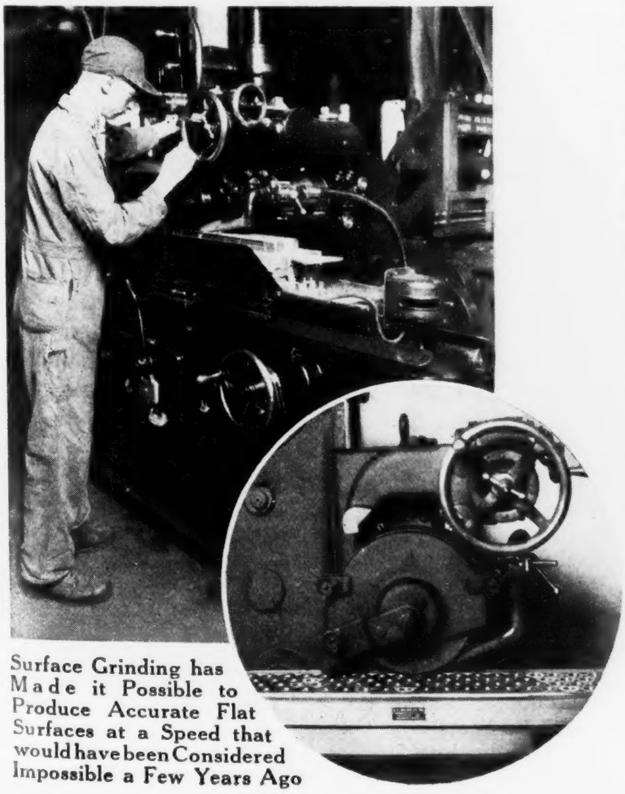
Probably $8,000,000 worth of grinding wheels are used in the automobile industry alone.

Certain materials, like manganese steel, cannot be machined by ordinary tools, but depend entirely upon the abrasive wheel to remove excess metal, so that the parts will be suitable for the purpose for which they are intended.

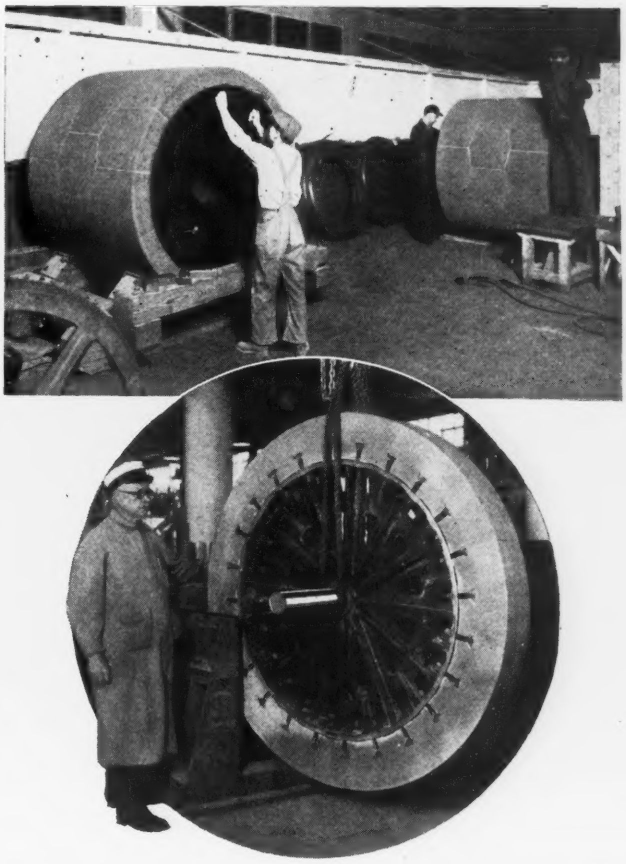
The story of grinding would not be complete without describing the development of electric furnace abrasives. Any motion picture audience, whether made up of technical or non-technical people, will be interested in the remarkable pictures in this film showing Niagara Falls, the hydroelectric power plants, and the scenes in the electric furnace plants where abrasives are produced. After having shown numerous examples of grinding in the various industries, therefore, the film continues to show how abrasives for grinding wheels are produced and how the wheels are made.

It shows how the ore from which the abrasive is produced is mined in Arkansas, and then sent to Niagara, where the world's largest hydro-electric plants are located. These plants furnish the power for the electric furnaces in which the aluminum ore is transformed into extremely hard abrasives. The picture shows how crushed ore is gradually fed into electric furnaces where, at a heat of about 3700 degrees F., the ore is fused and a new substance thereby produced—the abrasive used for grinding wheels.

Next the picture takes the observer to the wheel plant of the Norton Co. at Worcester, Mass., where the abrasive is crushed and carefully grained in more than twenty-five different sizes, varying from the fineness of the finest flour to the size of large peas. The interesting thing about all these different sizes is that all grains—the smallest and the largest—when viewed under a microscope, have exactly the same physical characteristics—the same sharp points and angles.



Surface Grinding has Made it Possible to Produce Accurate Flat Surfaces at a Speed that would have been Considered Impossible a Few Years Ago

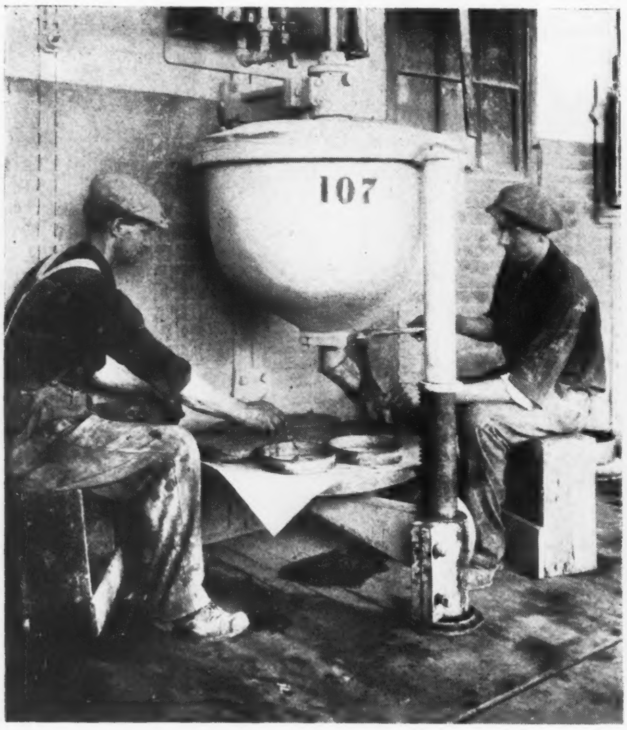


(Above) Large Abrasive Pulp Stones Used in Grinding Wood to Pulp in Paper Mills; (Below) Segmental Grinding Wheel 72 Inches in Diameter

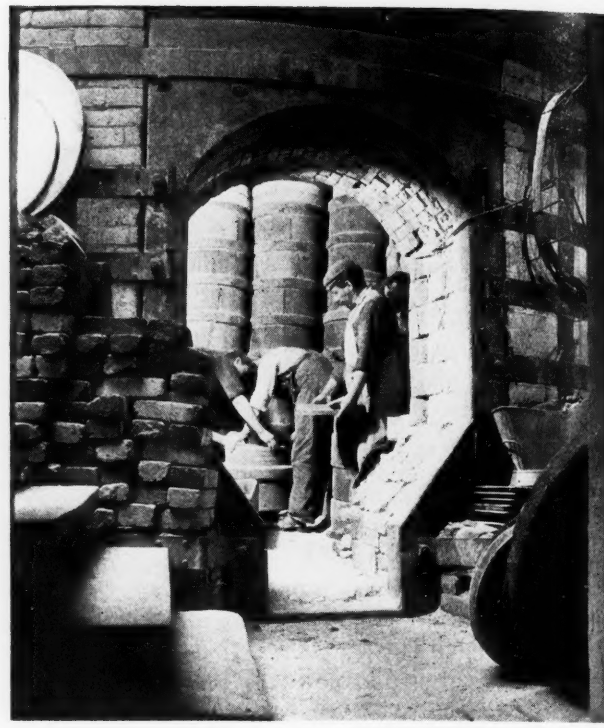
Next the film shows the actual making of grinding wheels. One sees how the required amount of the proper grain size is carefully weighed, the requisite bonding material added, together with water, and the mixture drawn off in forms and placed in a drying room. After drying, the wheels are firm, but can still be easily shaped, after which they are vitrified or burned in enormous kilns, in order to fasten the abrasive firmly in the bond. One of these kilns of the continuous type is 350 feet in length.

The wheels are loaded on cars or trucks and pass through the kiln in a continuous stream. During the first part of the journey, the wheels are not subjected to direct heat, but are gradually warmed up to meet the intense heat of 2400 degrees F. which it encounters for some 150 feet in the central section of the kiln, after which the wheels are permitted to cool slowly. Every three hours a car, having completed its slow journey through the kiln, is removed and another car is started at the other end of the kiln.

The picture also shows the numerous operations required for making grinding wheels of a great number of shapes and sizes. In addition to solid wheels, ranging from 1/8 inch to 4 feet in diameter, it is now possible to make much larger wheels by assembling them from segments. Some of these large segmental wheels are used in other than the metal-working industries. In the paper industry, for example, great grinding wheels are used for reducing the wooden logs to pulp. These huge pulp stones weigh 11 tons apiece, and yet are so carefully balanced that they are held within 5 ounces of perfect balance.



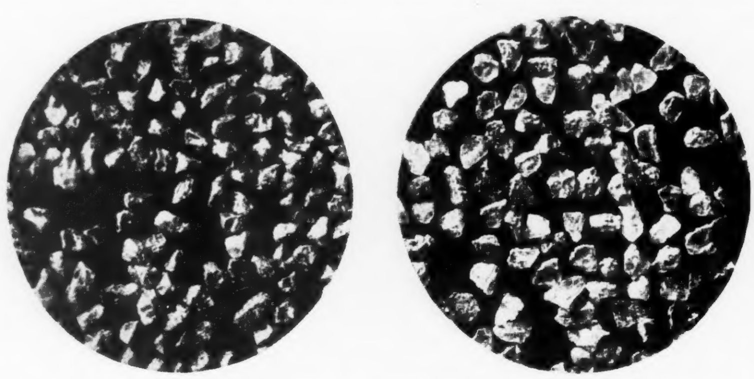
Mixing Materials for Grinding Wheels in Large Kettles and Pouring into Molds



The Loading of Grinding Wheels into a Kiln Prior to the Final "Burning" of the Wheels

The film ends with pictures of a number of grinding operations in varied lines of industry. Showing operations in each field, the film tells how grinding is used in making almost everything from axes to locomotives; from tiny dental cutters to the rolls that enable the great gates of the Panama Canal locks to turn with ease; from fountain pens to huge printing presses; and so on through the entire line of industrial production, contributing its essential part to this "Age of Speed."

The film will be made available by the Norton Co. to schools, colleges, Y. M. C. A.'s, engineering societies, foremen's groups, civic clubs, etc., and will be found of equal interest to technical and non-technical audiences. It goes a long way toward the solution of the vexing problem of how to make an educational picture interesting and entertaining. It is a credit to the motion-picture art as well.



Abrasive Grains Look Exactly Alike, Whether in the Form of Fine Flour or Large Grains. The Picture to the Left is Magnified Several Times, as Compared with the Picture to the Right

Cleveland Exposition Enlarges Exhibition Area

The National Machine Tool Builders' Association has announced that arrangements have been completed for a unique Canopy Arcade which will accommodate about thirty additional exhibitors in the National Machine Tool Builders' Exposition to be held in Cleveland September 19 to 23. The arcade will have power and other exhibit service the same as the main exhibition building. The floor is regular concrete street surfacing, and will therefore provide proper facilities for operating machinery displays. It became necessary to make every effort to add additional exhibition space, because sixty prospective exhibitors were unable to find space in the main exhibition building, which, despite its size, was quickly reserved in its entirety by the 150 exhibitors whose booths will be located there; a list of these exhibitors was published in March MACHINERY. The new arcade will provide space for the additional exhibitors listed below. The exposition office is located at 225 W. 34th St., New York City. The office of the association is at 630 Vine St., Cincinnati, Ohio.

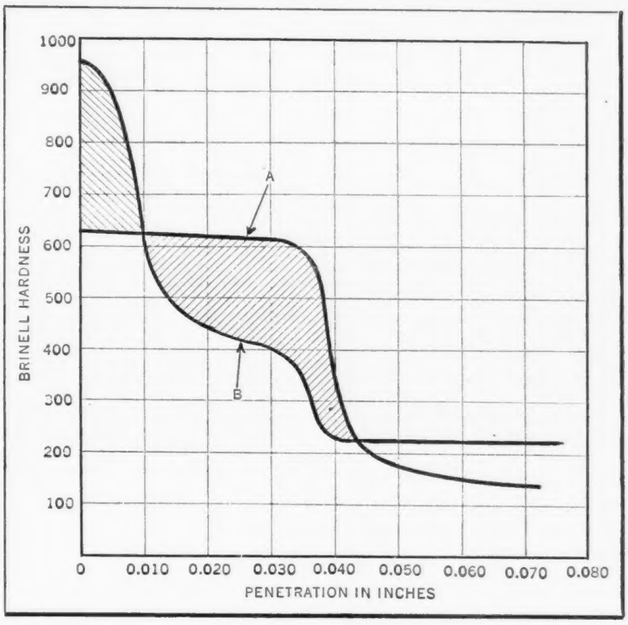
Anderson Bros. Mfg. Co.
Automotive Industries
Bearium Bearings, Inc.
Beatty Machine & Mfg. Co.
Buckeye Portable Tool Co.
Clipper Belt Lacer Co.
Goss & DeLeeuw Machine Co.
Hall Planetary Co.
Hanchett Swage Works
Higley Machine Co.
Hyatt Roller Bearing Co.
Hydraulic Press Mfg. Co.
Industry Illustrated
Iron Trade Review
Kingsbury Machine Co.
LaSalle Tool Co.
Link Belt Co.
Madison Kipp Corporation
Morton Mfg. Co.
Oakite Products, Inc.
Oster Mfg. Co.
Ramsay Chain Co.
Safety Emery Wheel Co.
Sun Oil Co.
Tuthill Pump Co.
United States Electrical Tool Co.
Universal Standard Sales Co.

Nitration Hardening

A Process for Casehardening Steel Parts by Heating Them in an Atmosphere of Nitrogen

A GAS process of casehardening steel parts known as nitration hardening has been described in British *Machinery* (London). This article is an abstract, giving the most essential information. The process, as compared with ordinary casehardening, is considered preferable when a moderate surface toughness and particularly high resistance to wear are desired, together with freedom from distortion. For particularly high surface pressure, practice has indicated that carburizing by the ordinary method is preferable to nitration hardening, owing to the greater carrying capacity of the hardened surface.

The endurance of nitrogen-hardened steels when continuously stressed was shown by alternating stress tests. In these tests, a hammer was made to fall upon a revolving test piece. Pieces hardened by the ordinary methods broke quickly under this test, whereas nitrogen-hardened parts withstood a very large number of blows, one test piece withstanding 14,000,000 blows.



Hardness Depth Curves for Carburized and Nitrogen-hardened Steels

Nitrogen-hardened parts retain their hardness after being refined, provided the temperature does not exceed 500 degrees C. (932 degrees F.), and the steel cannot be cut by a file at this temperature; hence, nitrogen hardening is particularly suitable for parts that must withstand comparatively high temperatures and still retain the initial hardness.

Parts not Distorted by Nitration Process

Casehardening provides a glass hard surface, but unfortunately possesses certain disadvantages, the necessary quenching frequently causing irregular changes of shape which can only be removed by grinding to size. With particularly delicate pieces, ordinary casehardening cannot be used, as the required economy and freedom from distortion cannot be obtained.

With the idea of overcoming these difficulties the nitration process has been evolved. This process eliminates the causes of the irregular changes of shape found in the ordinary methods of casehardening, and, what is more important, is carried out at a lower temperature and without quenching. Nitrogen is used as the casehardening medium, since it permeates iron at temperatures above 250 degrees C. (482 degrees F.) and gives, to suitable steels, a very hard outer surface.

The nitrogen hardening process requires careful and intelligent use. Recently a considerable number of tests were made in order to ascertain the limitations of the process, and as a result, this description of the procedure and its characteristics can be given. Parts for nitrogen hardening are made from the special steels suited to the process, and are fully finished. Grinding allowances are usually superfluous, owing to the almost complete absence of distortion. Should they be required, they may be reduced to about 0.002 or 0.003 inch.

It is important to realize that this process is only applicable to certain steels. In the case of mild steel, the penetration is rapid, and needles of ferrous or ferric nitride form, rendering the surface exceedingly brittle. In the case of steels containing chrome, silicon, and especially aluminum, the case is shallow, reasonably tough, and very hard. A silicon manganese steel of 0.06 per cent silicon and 0.17 per cent manganese showed an increase after being hardened by the nitration process of from 299 to 388 Brinell, and a steel of 0.18 per cent carbon and 0.22 per cent vanadium showed an increase of from 157 to 317 Brinell.

Type of Furnace Used and General Procedure

The actual operation of nitrogen hardening is very simple. For heating, the electrical resistance type of furnace is usually employed, adjusted for a temperature range of 450 to 600 degrees C. (842 to 1112 degrees F.) The furnaces are heavily insulated, so that the current consumption is small. As an example, a furnace with an output of 22 tons per month required only 8 kilowatts to hold it at the given temperature. The larger types of furnace are operated by direct current from transformers, while smaller types of furnace are operated by direct or alternating current of 110 to 120 volts without transformers.

In the nitrogen furnace, the parts to be hardened are placed in specially constructed gas-tight boxes, the pieces being packed in such a manner

that the gas has access to all surfaces. With the larger types of furnaces, the boxes are run in by means of a special conveyor, which is so constructed that when a finished box leaves the furnace a box containing unhardened parts enters the furnace. A stream of ammonia gas is passed through the boxes as they enter the furnace. The temperature is ascertained by means of thermocouples placed in each box and registering on a temperature recorder.

When a cold box enters the furnace, the current strength is raised by a simple arrangement of switches to about three times the normal. The time for raising the charge to the desired temperature varies, according to its bulk, from about one to seven hours; thereafter the temperature is held constant from one to five days, depending on the shape and size of the parts to be hardened.

After the hardening is completed the box is removed from the furnace and cooled in the air. The operation of the furnace is simple and clean and does not require skilled labor. The parts generally leave the furnace fit for use, the outer surface retaining a fine finish. A faint tinge of gray or mottled coloring, peculiar to nitrogen hardening, may easily be removed by polishing.

This method of hardening parts completely avoids irregular changes of shape, provided the parts are free from forging stresses when put in the furnace. It is, of course, necessary to anneal any delicate parts after forging or rough-machining, so as to remove any stresses that may have been so caused. The annealing should be carried out at a temperature of from 500 to 600 degrees C. (932 to 1112 degrees F.) With simpler and less delicate parts, annealing is not required.

Although no distortion results from the treatment, an increase of volume may occur due to the absorption of nitrogen. With symmetrical pieces such as bolts and axles, there is a slight increase of about 0.001 inch in thickness. The change of size becomes particularly noticeable in thin-walled, ring-shaped parts, the nitrogen here penetrating a considerable portion of the section and causing a regular increase of width. With wall thicknesses of 0.4 inch or over, the increases in width are so unimportant that they can be neglected. As against the ordinary method of casehardening, the new process has the advantage that the change of shape follows a regular law, while rings treated in the usual manner suffer irregular distortion and lose their circular shape.

Hardness of Outer Layer

The illustration shows the hardness depth curves of carburized (*A*) and nitrogen-hardened (*B*) special steels for a depth of penetration of about 0.04 inch. These curves indicate that the nitrogen process produces a glass-hard outer layer, the hardness of which far exceeds that produced by the ordinary carburizing method, attaining values of between 900 and 1000 Brinell (these values were ascertained by means of the Herbert pendulum hardness tester).

The carburizing method produces a hard outer layer, the hardness of which is less than that of the nitrogen process, reaching about 630 Brinell, but the penetration is somewhat greater and can, in case of need, be made to exceed 0.04 inch, which is the greatest depth that can be obtained by the new method.

The transition from the hard outer layers of nitrogen-hardened parts to the soft core is so gradual that there is no danger of the case peeling off. On account of the extreme hardness of the surface, local overloading is to be avoided, and the sharp corners of all parts should be rounded off.

Parts Hardened by the Nitration Process Withstand Shocks

Experience has shown that parts exposed to the wear and tear of road shocks give considerably longer service when hardened by the nitrogen process than by any other method. A nitrogen-hardened crankshaft run under very severe conditions showed only one-fifth of the wear of a crankshaft hardened by the ordinary method and doing the same duty. The process is also suitable for the hardening of driving chains.

The nitrogen-hardened outer layer does not suffer from plastic deformation, but considerable elastic deformation can take place without injury. Nitrogen-hardened shafts can be deflected under load, and will return to their original positions without loss of accuracy. Permanent deformation first takes place when the load reaches a point where the hardened layers commence to peel off, and takes the form of fine, evenly spaced cracks.

Nitrogen hardening permeates the entire outer surface, and in producing nitrogen-hardened parts care should be taken to see that lubrication holes and other details are machined before hardening. The special steels used can be worked in almost every possible manner. They can be forged, rolled, drop-forged, hot-pressed, drawn, and cast. Forged steel is preferable to cast steel, but these steels should not be forged after they have reached the brittle stage. Except for cutting tools and parts that have to withstand high surface pressure, nitrogen hardening may be used wherever hardened parts are required.

Cost of Nitration Hardening

A general idea of the relative costs of nitrogen and ordinary casehardening may be obtained from the following examples: Ten heavy cross-head slippers cost 24 per cent less to harden by the nitrogen process than by ordinary carbon hardening, and the nitrogen process showed a reduction of 50 per cent in hardening 1000 small shafts. The price of the special steels used is about the same as that of ordinary chrome and chrome-nickel steel.

An additional saving is effected in the case of nitrogen-hardened parts, since subsequent grinding and cleaning are unnecessary; moreover, hardening failures are few. Nitrogen hardening cannot and should not wholly displace the ordinary carburizing process, but it forms a valuable supplement to previously known methods, while for cheapness of manufacture and durability it would seem to stand unrivalled for many purposes.

* * *

Electric arc welding is now applied extensively in the construction of generators and motors.

Manufacturing Milling Machine Arbors

Methods and Equipment Used in Making Standard Milling Machine Arbors on a Production Basis in a Specialized Department

By FREDERICK B. HEITKAMP, Cincinnati Milling Machine Co., Cincinnati, Ohio

THE two main requirements of a satisfactory milling machine arbor are accuracy and sufficient strength to stand up under the stresses imposed by the heavy cuts taken in modern milling practice. To obtain these results, it is necessary not only to have carefully planned and developed manufacturing methods, but also a highly systematic inspection and supervising system for checking the work.

The purpose of this article is to describe how the work of manufacturing milling machine arbors is organized at the Cincinnati Milling Machine Co.'s plant, where for many years it has been the practice to produce arbors by running them through the regular production line in the shop. Recently a careful investigation has been made of the manufacturing methods, and further steps have been taken to improve the processes wherever possible.

Separate Department for Arbor Manufacture

A separate department has been organized under one supervising head, this department being, in effect, a separate plant for the production of arbors. Several advantages are obtained by this change in manufacturing methods. Stock tracing has been practically eliminated, and the progress of the work has been speeded up; also, by having all the machines arranged progressively and many of them set up permanently for one operation, much time is saved over the old method of setting up and tearing down the tooling equipment for a small lot of arbor forgings.

The same operators remain in this one department, and as they are frequently assigned for long periods to one operation, they become very expert in their work. As they are continuously working on the same parts, they are held responsible for the preliminary inspection of their own work, which, in addition, is checked by the regular inspectors as a double safeguard. By systematizing the work, however, the total inspection time has been reduced.

The transporting of material from one department to another, which was necessary by the old scheme, has been materially reduced, and all waste of time in handling materials has been eliminated. Due to all these factors it has been possible to improve the quality, increase the production, and lower the costs at the same time. To do so, however, required the installation of about 50 per cent additional machine tool and other shop equipment. Actual figures showed that it was advantageous to make this additional investment in order to insure quality and efficiency in the manufacturing operations. A general view of the arbor department is shown in the heading illustration.

Photo by Bachrach

Frederick B. Heitkamp

FREDERICK B. HEITKAMP was born in Brooklyn, N. Y., in 1896. He attended the Chatham High School, Chatham, N. J., and graduated from Rutgers University in 1917. Later he was associated with the General Motors Export Co. and the Durant Corporation, and in 1921 he entered the employ of the Cincinnati Milling Machine Co., where he is now manager of sales promotion and director of publicity. Mr. Heitkamp is also chairman of the Advertising Committee of the National Machine Tool Builders' Association, and vice-president of the Cincinnati Industrial Advertisers' Association. He has contributed articles to trade journals in the United States, Canada, and England.

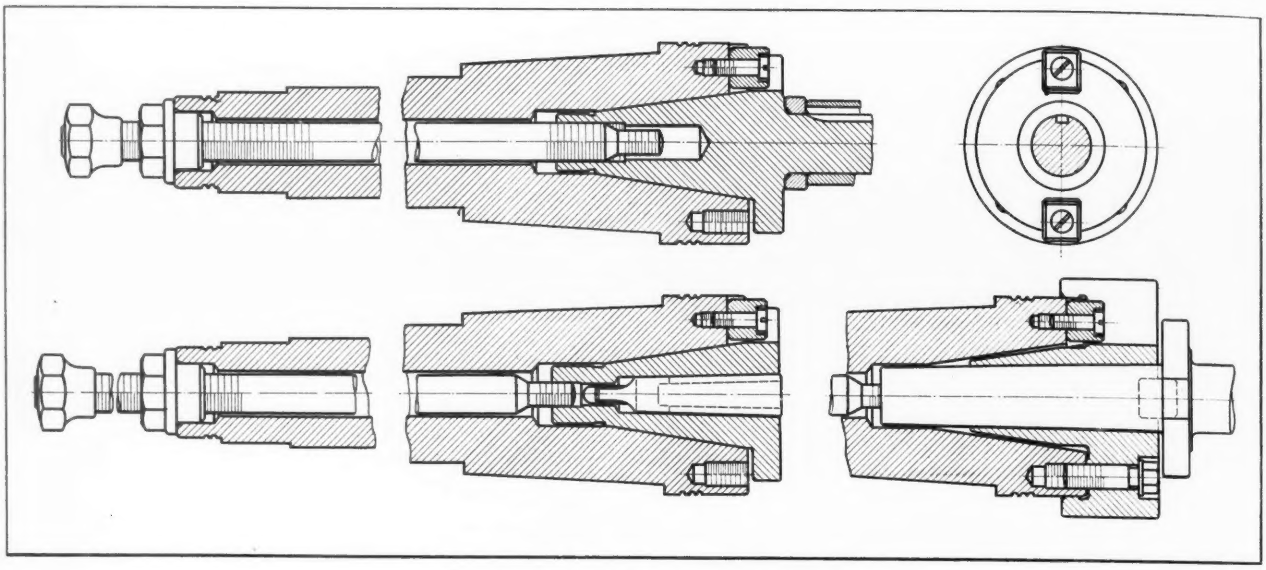


Fig. 1. The New Standard Arbor for Milling Machines

New Standard Arbors for Milling Machines

Fig. 1 represents a sectional drawing of milling machine spindles provided with the new national standard arbors embodying the new taper agreed upon by milling machine manufacturers, an announcement of the adoption of which was made a month ago. This development will be welcomed by milling machine users because, through this standardization, they will be able to reduce the number of cutters and arbors kept in stock, and will be able to interchange their arbor and cutter equipment on milling machines of different makes.

The new standard makes it easier to remove the arbor from the spindle, and at the same time it puts less strain and wear on the spindle, because it eliminates the strenuous efforts sometimes required in the past to remove the arbor. In addition, there is the advantage of a powerful drive for the cutter, thereby insuring the maximum value of the power in the machine and the metal removing ability of the cutter.

In the manufacture of these standard arbors, standard keyways are milled the entire length of the straight end. The width of the collars is such that a minimum number of collars is required for any given cutter assembly. The collar widths are so selected that cutters varying by 1/8 inch in width may be assembled on the arbor without the necessity of using special collars.

Material from which the Arbors Are Made

All the arbors are forged from chrome-nickel steel, and test specimens of the metal must show a yield point of about 150,000 pounds per square inch after having been subjected to the required heat-treating process. This process consists of four distinct heat-treatments, all carried on in electric furnaces of such design that the distribution of heat throughout a quantity of arbors will be as nearly uniform as possible. A pile of arbor forgings, as they are received from the forge shop, is shown in Fig. 2. A finished arbor is shown in the foreground of the illustration.

The arbors, as received from the forge shop, are made sufficiently long to allow of metal being cut off for chemical tests. These tests consist of accurately determining the carbon, nickel, chromium, manganese, phosphorus, sulphur, and silicon contents. For the purpose of making these tests, a special chemical laboratory is maintained, as shown in Fig. 6. This laboratory is equipped to make extensive physical tests, as well as chemical analyses, and is under the charge of competent chemists.

Before any machining work is done on the arbor forgings, they are subjected to a preliminary normalizing treatment, consisting of uniform heating to above the critical temperature, followed by slow cooling in a normalizing furnace. The object of

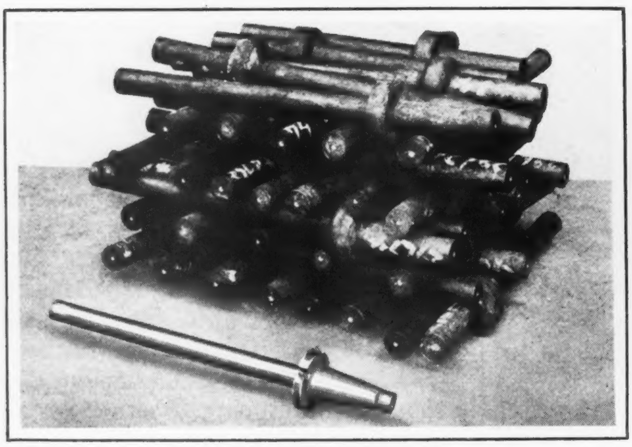


Fig. 2. A Pile of Milling Machine Arbor Forgings and a Finished Arbor

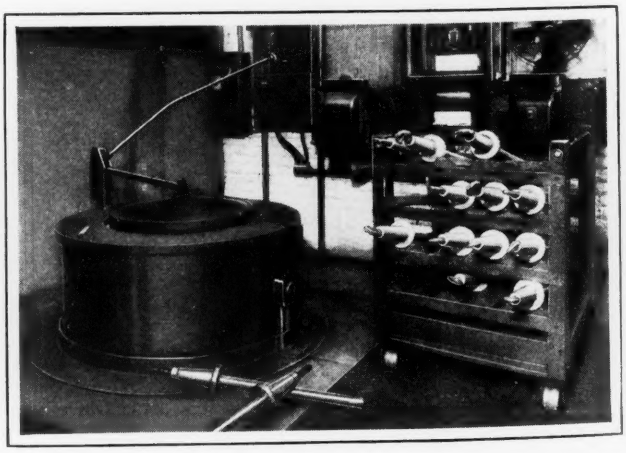


Fig. 3. "Hump" Electric Furnace for Heat-treating the Arbors

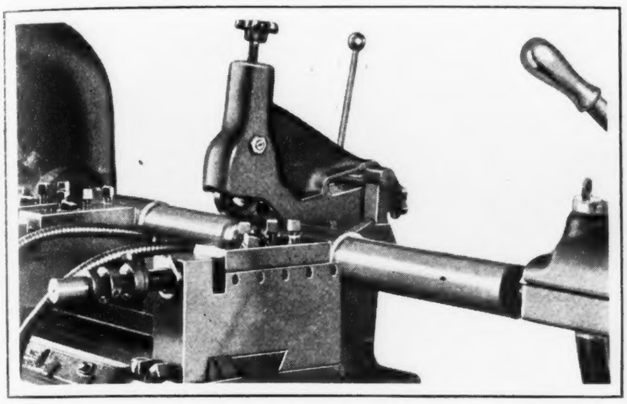


Fig. 4. Special Tools Used in Turning the Arbor—Note Depth of Cut

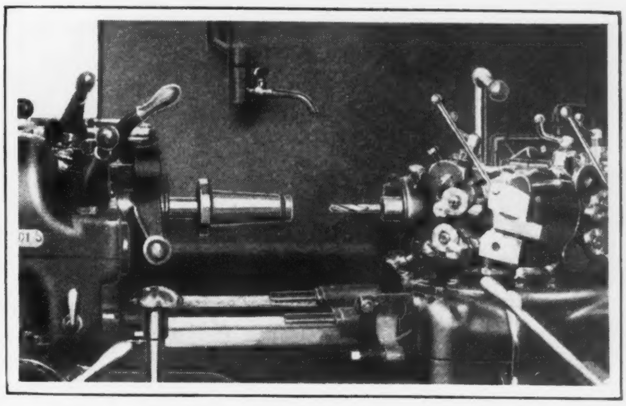


Fig. 5. Machining Tapered End and Drilling and Tapping Hole

this treatment is to relieve all forging strains and to make the arbors uniform in grain structure, allowing the tough chrome-nickel steel to be machined more easily, and thereby reducing the production cost. Care must be taken to see that the arbors are not bent while normalizing, and for that reason the forgings are suspended in a vertical position while heating, and allowed to remain in this position while cooling in the furnace. This keeps warpage down to a minimum.

Turning the Arbors

Not less than 3/8 inch of stock (on the diameter) is removed from the arbor forging. It is considered necessary and desirable to remove this amount of metal, in order to eliminate all the decarbonized surface and other surface defects. The arbors are then inspected for any defects in the material visible after the first machining process, and frequently forgings are rejected at this time because of flaws. Fig. 4 shows the turning operation; it will be seen that the lathe is equipped with special tools for quick and accurate turning. This illustration shows the depth of cut that is taken to remove such defects as forging cracks and seams and non-uniform metal.

The tapered end of the arbor is then drilled, tapped, and recentered in a flat turret lathe, tooled up solely for these operations, as shown in Fig. 5. By performing all these operations in the same machine, the concentricity of the hole with the outside taper is assured.

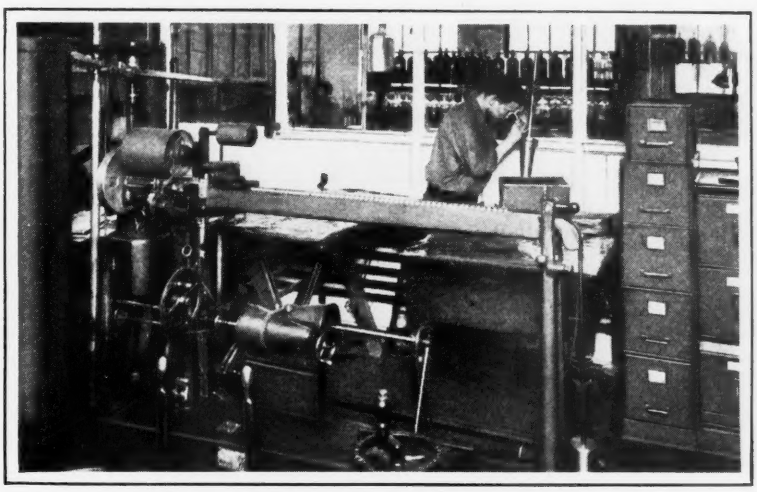


Fig. 6. The Testing Laboratory that Insures Uniformity and Quality of Product

Heat-treatment and Hardness Tests

One of the most important processes through which the arbor passes is the heat-treatment, as upon this depend entirely the strength, rigidity, and hardness of the arbors, which, in addition to accuracy, are the main requirements in a milling machine arbor. After heat-treatment, the arbors are subjected to severe physical tests. Every arbor is tested for hardness in a Brinell hardness testing machine, and the hardness must not vary more than a few points above or below the required Brinell reading. This testing equipment is shown to the left in Fig. 7. Arbors that do not pass this hardness test are rejected in order to maintain uniformity of quality in the product.

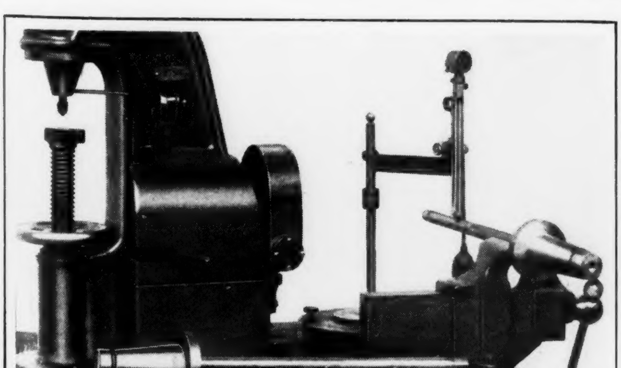


Fig. 7. Brinell Testing Machine and Shore Scleroscope for Testing Hardness of Arbor

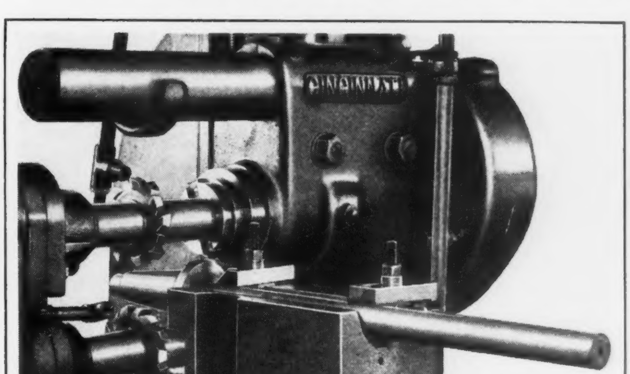


Fig. 8. Milling the Two Slots in the Arbor Flange Simultaneously

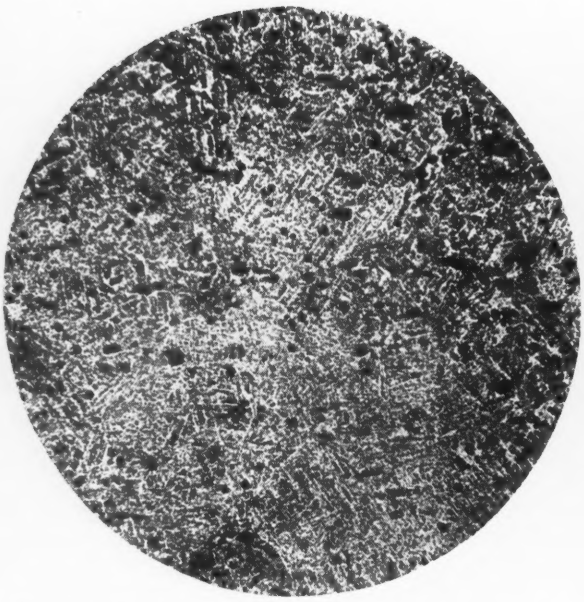


Fig. 9. Photomicrograph of Steel in Arbor Forging (Magnification 100)

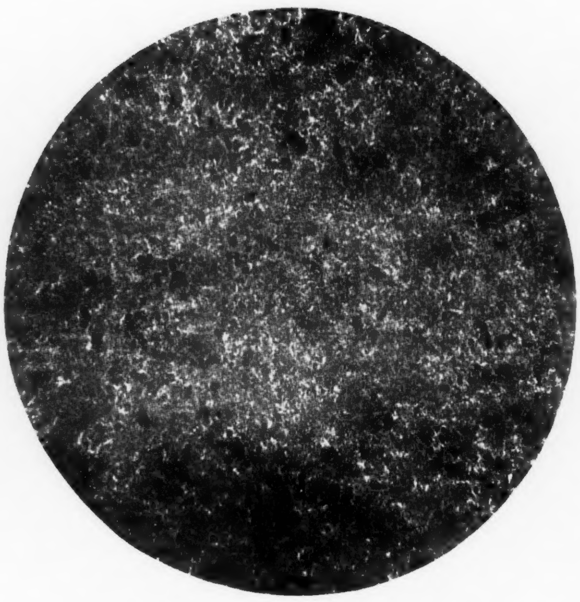


Fig. 10. Photomicrograph of Steel in Heat-treated Arbor (Magnification 100)

For the heat-treatment, a Leeds & Northrup "hump" electric furnace, as shown in Fig. 3, is used. When the heat-treatment is correct, the internal structure of the steel should be changed without appreciable external changes. To obtain the best results—that is, to eliminate distortion and warpage while retaining the fine grain structure necessary in a properly heat-treated arbor, specially designed electric furnaces have been installed.

The handling of the arbors is further facilitated by inserting a loosely fitted hook in the threaded end of the arbor, as shown in Fig. 3. This is done so that the arbor may be suspended in a vertical position in the furnace, as already mentioned. The arbors are heated to the required temperature and are allowed to soak from one to two hours, depending upon their diameter. They are then quenched in oil held at a constant temperature while still hanging in the vertical position. The temperature of the oil is automatically controlled by a thermostat. The end of the arbor that is tapped for the draw-in bolt is then heated in a lead pot and quenched in oil so that the end of the arbor will be very hard to resist any rough treatment that it might be subjected to when in use in a machine shop.

The scleroscope, shown to the right in Fig. 7, is used for testing hardness at the end of the arbor. In addition, a constant watch is kept for defects that may show after each operation. Arbors having such defects as forging flaws and laps, seams, or cracks, those that are warped, and those that do not have the required hardness are rejected. These rejections are expensive, and frequently an inspector would be tempted to let a minor defect pass, but he is instructed to maintain the highest possible quality and to follow the regulations laid down for him, no matter what the rejections may be.

Figs. 9, 10, and 11 show photomicrographs to 100 magnification, indicating the grain structures obtained from the special heat-treatments. Fig. 9 is a photomicrograph of a section through an arbor before heat-treatment. This illustration shows the fine grain structure obtained in the original chrome-nickel steel forging.

Fig. 10 shows a photomicrograph of a section through the long straight portion of the arbor. This part must be hard and yet tough enough to withstand the severe loads caused by cutters jamming or striking hard spots in the work. The illustration shows the grain structure that is obtained by careful heat-treatment and that insures combined toughness and hardness.

Fig. 11 shows a section through the hardened tapered end of the arbor; this indicates a very fine hard grain structure which will withstand any abuse to which the arbor may be subjected by the draw-in bar.

Fig. 11. Photomicrograph of Steel in Hardened Tapered End of Arbor (Magnification 100)

Rough Grinding, Milling, and Threading Operations

The arbors are now ready to be rough-ground to dimensions approximately 0.001 inch above the finished size. The chief purpose of this rough-grinding is to maintain the greatest possible accuracy in the subsequent machining operations.

The next operation is to mill the upper and lower slots in the arbor flange for the driving key, both slots being milled simulta-

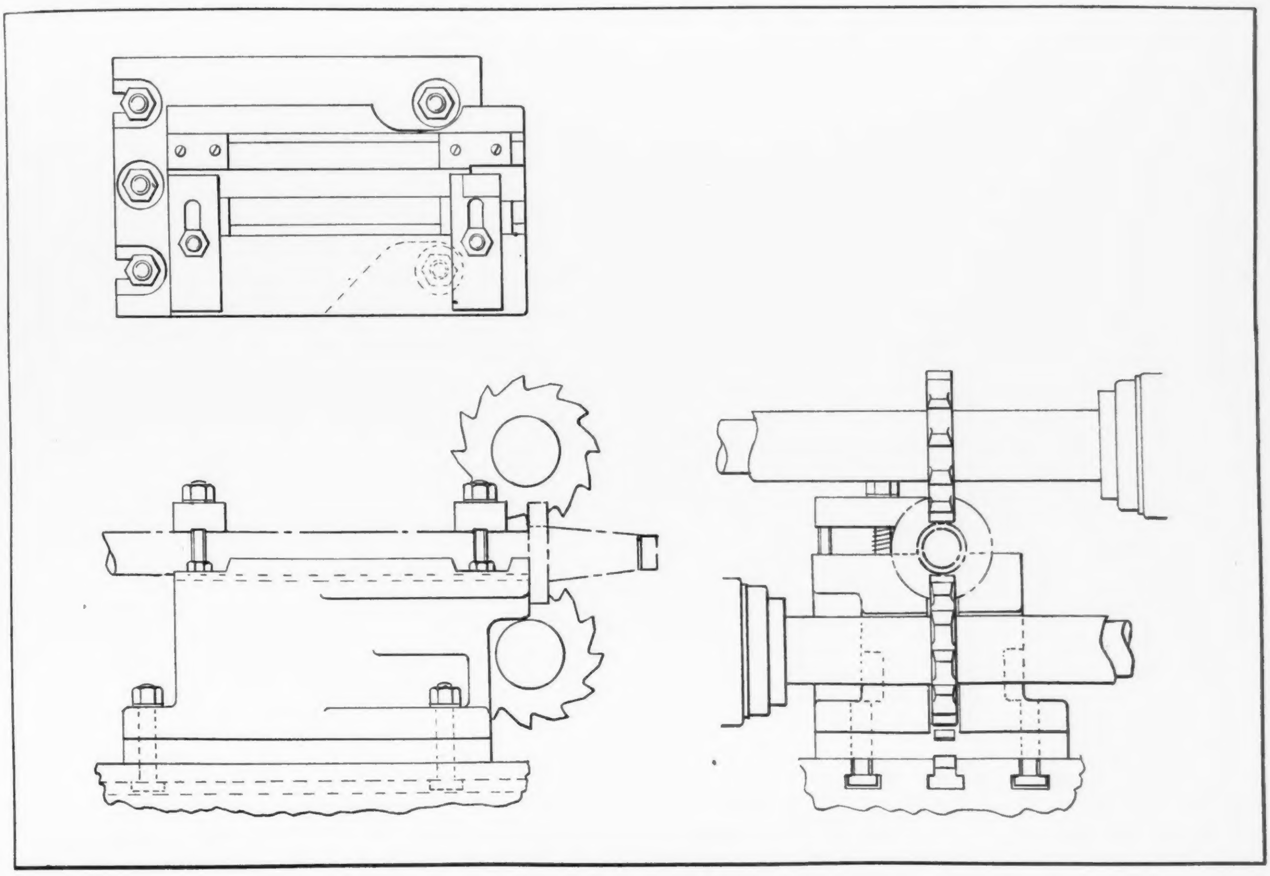


Fig. 12. Fixture Used when Milling Arbor Slots

neously in a 48-inch automatic duplex miller equipped with a special fixture, as shown in Fig. 8. By milling both slots at one time, costs were decidedly reduced as compared with the single-cut indexing method. Fig. 12 shows the fixture in detail.

The next operation is to cut the keyway in the arbor, which is done by the usual method with a slotting cutter mounted in an 18-inch manufacturing miller. The thread for the nut is then chased in a lathe in order to obtain the best possible fit, special care being taken to have the thread for the nut accurate in relation to the arbor axis, so that the nut will be square with the face of the arbor collar and can be easily put on and taken off.

The Finish-grinding Operation

The finish-grinding operation may be considered equal in importance to the heat-treating. Good grinding machines, skilled operators, and the best known methods of testing the finished work are the factors that insure satisfactory results.

The taper is accurately ground with a very high finish, and is tested by a specially constructed "light" gage. This gage, which is shown in Fig. 13, has been designed to allow the operator to handle the arbor quickly and easily. A strong light is placed inside the testing box, and as the arbor is placed in the previously set master gage, inaccuracies are easily detected.

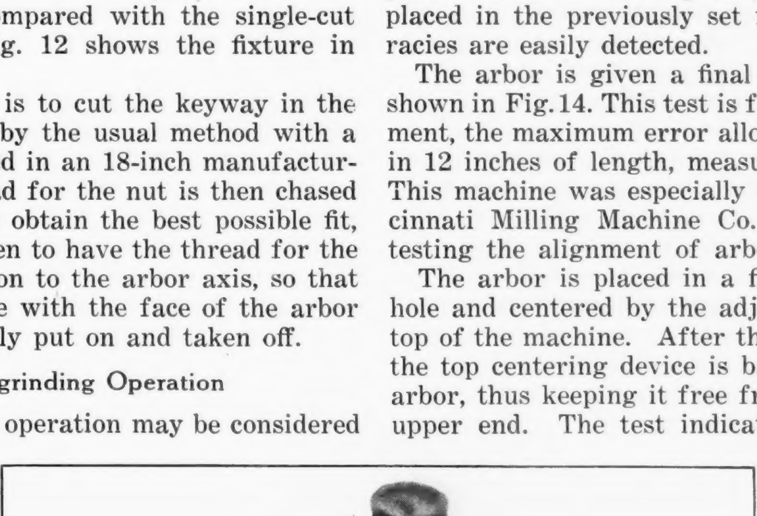


Fig. 13. Testing the Tapered End of the Arbor for Accuracy

The arbor is given a final test on the machine shown in Fig. 14. This test is for determining alignment, the maximum error allowed being 0.001 inch in 12 inches of length, measured from the flange. This machine was especially designed by the Cincinnati Milling Machine Co. for the purpose of testing the alignment of arbors.

The arbor is placed in a flange with a tapered hole and centered by the adjustable center at the top of the machine. After the arbor is so located, the top centering device is backed away from the arbor, thus keeping it free from all support at its upper end. The test indicator is placed against the arbor, which is then rotated by the handwheel shown to the right. Arbors in which the maximum error exceeds that mentioned are rejected. The arbor is pushed out of the flange by rotating the handwheel to the left. Both unassembled and assembled arbors are subjected to this rigid test.

The assembled arbor brings us to the matter of spac-

ing collars, bearing collars, and nuts. These parts are very important, for no matter how much care is taken in the manufacture of the arbor, it cannot be used to produce accurate work unless the collars and nuts have been carefully machined to preserve the alignment.

The Making of Hardened Collars for Arbors

The bearing and spacing collars are hardened, and all surfaces ground. After hardening, the

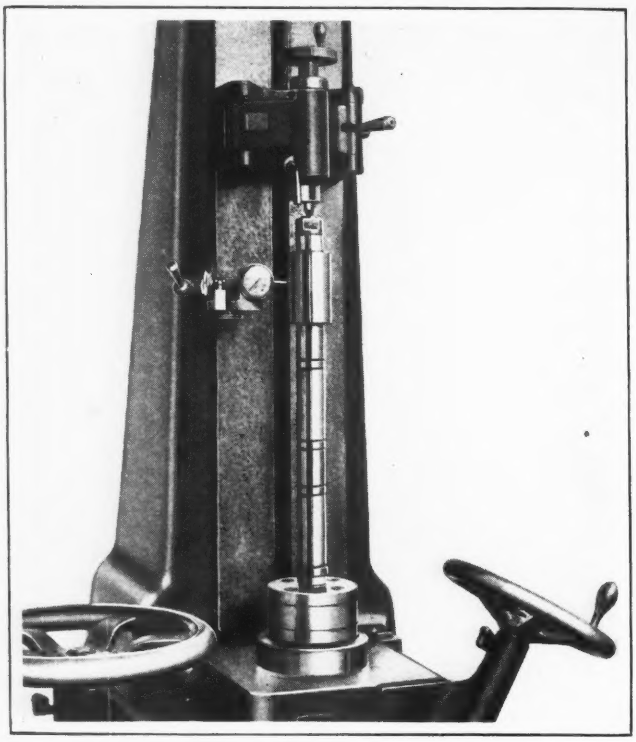


Fig. 14. Testing the Alignment of the Arbor by a Special Testing Machine

spacing collars are run through a centerless grinder, as shown in Fig. 15, and rough-ground on the outside. Then the outside diameter is finish-ground on a centerless grinding machine. On the finish-grinding operation, a limit of plus or minus 0.0001 inch of parallelism is maintained between the ends of the collar, in order to insure alignment of the assembled arbor. The hole is

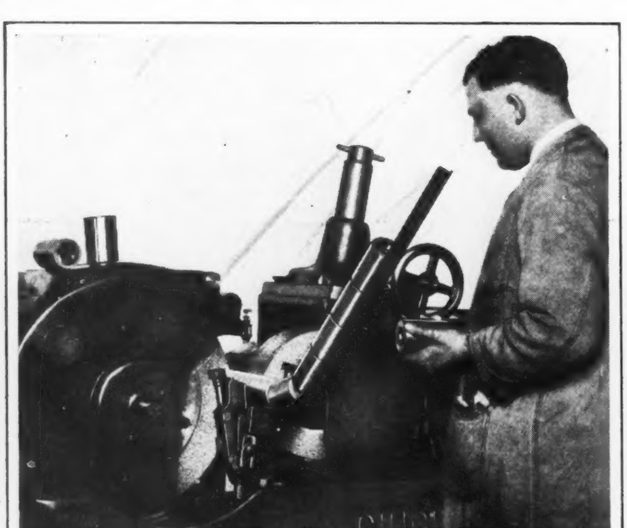


Fig. 15. Grinding the Spacing Collars in a Centerless Grinding Machine

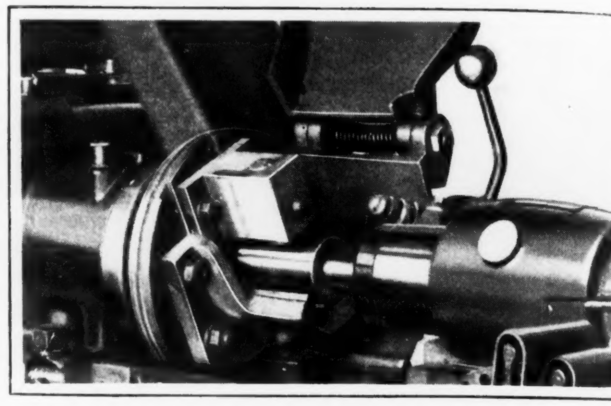


Fig. 16. Grinding the Holes in the Spacing Collars on an Automatic Internal Grinder

then ground on an internal grinding machine, as shown in Fig. 16. The importance of hardened steel collars should be appreciated, because when the collars are hardened, the alignment of the arbor is not so easily destroyed, nor is the collar so easily marred by rough usage.

The bearing collars are first rough-ground on a centerless grinding machine. The hole is then ground on an automatic internal grinding machine, after which the outside is finished on a cylindrical grinder. Absolute concentricity is thereby main-

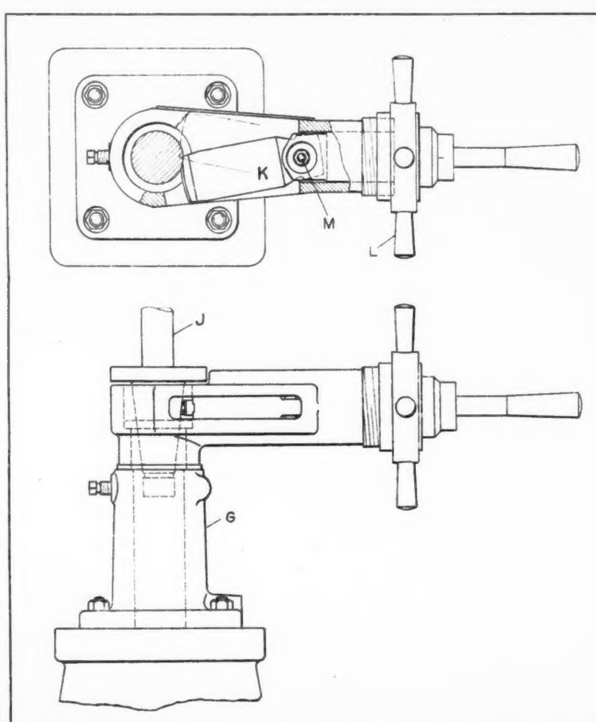


Fig. 17. Device Built Especially for Marking the Arbors

tained between the hole and the outside. As before, a limit of plus or minus 0.0001 inch in parallelism is maintained between the ends. The hole is also kept to size within plus or minus 0.0001 inch. The face of the hardened nuts is ground square with the threads to insure accuracy in the assembled arbor.

The catalogue and style numbers of the arbors are rolled on them by a special device designed and built by the Cincinnati Milling Machine Co., as illustrated in Fig. 17; G is the base of the fixture which holds the work J; K is the die which pivots about M, and is adjusted relative to the work by

the pilot wheel *L*. After marking, the arbor is completed.

The fact that should be emphasized in this connection is that these arbors are now standardized, so that they are interchangeable on all milling machines on which the standard spindle end is used, an advantage that milling machine users will not be slow to appreciate.

* * *

QUARTER-TURN BELT DRIVES

The Leather Belting Exchange Foundation of Cornell University has conducted a series of tests on horizontal quarter-turn belt drives. One of the objects of these experiments was to study the transmission capacity of horizontal quarter-turn drives as compared with normal horizontal drives. Another object was to test certain combinations of pulleys and center distances in order to ascertain more about the practical lay-out of quarter-turn drives.

In making these tests, the driving dynamometer of a 100-horsepower belt-testing apparatus was employed to drive a vertical countershaft through a quarter-turn belt, and the countershaft drove the absorbing dynamometer through the test quarter-turn belt.

The Transmitting Capacity

In a report of these experiments by R. F. Jones, research engineer, the following conclusions are given: First, at slips up to 1.5 per cent there is practically no difference in the transmitting power of a quarter-turn drive and a normal drive. Second, at the higher slips, the advantage is with the normal drive, especially with belts of high capacity. Third, if the center distance is within the limits of good practice, it has little if any effect on the difference between the two drives; in other words, center distance has no effect on this difference unless it is so short that the belt does not conform well to the quarter-turn drive.

Effect on Belt Width

For the purpose of design, a horizontal quarter-turn belt should be from 5 to 10 per cent wider than a normal belt, other conditions remaining the same. Under most conditions, an allowance of 5 per cent would be enough, but if the drive is severe, 10 per cent would be better. It is not certain that these figures would apply to a belt much wider than 4 inches, but they should if the belt conformed well to the drive, and was in good contact with the pulleys most of the way across the belt.

There is no theoretical reason why a quarter-turn belt should not be able to carry as much load as a normal belt, except that the tension varies across the width of the belt. The total area of pulley contact is certain to be less, because the short edge is not in good contact at certain points, but theoretically this should make no difference; practically it may have some effect. Furthermore, the effective arc of contact is actually greater on a quarter-turn belt than on a corresponding normal belt. It is true that the short edge of the belt does not come on the pulley as soon as the long edge, and in fact, it may not touch all the way around, but it is also true that the edge that is carrying the load makes contact with the pulley throughout the entire theoretical arc of contact, which is always greater than 180 degrees on both pulleys. Therefore, small differences indicated by the tests on the low-capacity belts are to be expected. The greater difference that was obtained at high slippage can be partly explained by the fact that this belt undoubtedly had a better coefficient of friction in the center than on either edge, where most of the contact on the quarter-turn drive came.

Relative Lengths of Long and Short Edges

In the trials of different quarter-turn drives, the length of the long and short edges of several drives was measured by placing a steel tape beside each edge of the belt. The difference in length of the two edges varied from 13/16 inch to 3 inches, the latter being the difference for a 30-inch pulley driving a 6-inch pulley, at six-foot centers. This is an impractical drive, but the belt stayed on, although the short edge was curling and crinkling badly as it left the small pulley. A 9-inch pulley was substituted for the 6-inch size, but it did not improve conditions much. At longer center distances, five times or more the diameter of the larger pulley, the long edge of a 4-inch belt would not be more than 1 1/2 inches longer than the short edge.

The difference in length of the two edges is caused by the fact that the same edge has to take the outside of the curve formed by the belt as it leaves either pulley, and the stress is usually greater on that part of the belt passing through the curve at the driven pulley. The shorter the center distance for any given pulley, the sharper this curve, and the greater the strain on the belt. Since the curvature depends upon the pulley diameter and the center distance, their ratio determines the maximum bend that the belt will have to make (which will be on leaving the smaller pulley). It follows, then, that this ratio has an important influence on the life of the belt. Belt life being an important factor in the choice of the minimum ratio between the center distance and the large pulley diameter brings in an economic problem that can be more easily solved by a study of quarter-turn belts in service than in the laboratory.

Squeaking of Quarter-turn Belts

A few remarks on points of general interest in the operation of quarter-turn drives might be of some value in this discussion. In almost every instance where a leather belt was installed fairly tight, a certain amount of squeaking occurred, even at no load. This was caused by the tendency of the belt to slip sidewise just before it left the pulleys. When the belt was under load, the squeak usually originated at the side where the belt left the driven pulley, because this was the tight side and naturally offered more resistance to sidewise sliding than the loose side. In the case of the 30-inch pulley driving the 6- and 9-inch pulleys at six-foot centers, the side slipping was great enough to cause heating of the smaller pulley.

Horizontal Pulley Should be Driver

In general, a quarter-turn belt will stay on the horizontal pulley better if the horizontal pulley is

used as the driver, because when it is driving, the loose or sagging strand of the belt comes on the driven pulley, which is in a vertical plane, and therefore, the belt will run true, regardless of the sag of the loose side. If the driver pulley is in a vertical position, the loose side of the belt feeds on the horizontal pulley, and the sag of this strand tends to make the belt run off the lower side of the pulley. When the load is variable, the belt has a tendency to run in a different place on the horizontal pulley for every change in load. Tightening the belt helps to overcome this trouble, which would be experienced more or less with loose belts, at long centers, or at high speeds.

* * *

GREATER CARE NEEDED IN SELECTING SMALL TOOLS

By A. L. WALKER

Today, practically every concern makes a careful study of the various machine tools available for a given class of work before making a purchase. The expense incurred in making such studies and investigations is generally fully justified by the resulting increase in production. But while considerable thought is given to a purchase involving amounts as large as those paid for a machine tool, not so much thought is given to the purchase of small tools, which cost a comparatively small amount. Accordingly, small tools are often chosen at random, or on a basis of first cost alone.

Managers are More Interested in Machines than in Tools

Some interesting facts regarding the conditions and problems encountered in selling small tools are presented by an experienced salesman of a large manufacturer of machine tools and equipment. By years of patient effort this salesman had won his way to the manager's office of each firm with which his concern dealt. If there was any new development in machine tools, he made a practice of passing the news along to his clients. The managers would always listen to him and discuss the advantages of the latest machine; but let him mention the fact that his firm was bringing out a new reamer that would reduce breakage costs, and the managers at once became uninterested, remarking that Mr. So-and-So, the buyer, had better be consulted.

This attitude amused the salesman, who often said that managers were concerned only with the means of guiding a tool and cared not one iota whether the business end of the tool were of lead or high-speed steel; yet not one of these men would think of buying a fountain pen without being assured of the quality of the nib. This analogy, in the writer's opinion, is not far-fetched.

It might be thought that with so many years of experience, the makers of small tools would all have approximated a standard for each type of tool and that there would be little to chose among different makes. Yet, if we go from one shop to another, we find that each has its favorite drill and tap, and so on down the list of small tools. The reason for this is chiefly that the "best" of each shop is often the one bought in the first place and the one with which the men are familiar.

Snap Judgment is too Often Responsible for Selection of Small Tools

It is a difficult matter to judge the respective merits of different tools under shop conditions. If sample reamers, for instance, are sent to the shop and the foreman asked to keep his eye on them so that he can judge their merits, he generally gives them to a gang boss with the instructions he received. Unless the samples are very poor, the matter usually rests there until further inquiry is made. If some day the foreman is asked what he thinks of the reamers, he passes the question on to the gang boss who, being expected to say something, remarks that they are "not bad" or "about the same as we are using" and so the matter drops. Without definite and well-planned tests, it is almost impossible to tell which is the better of two reasonably good tools.

The importance of using care in selecting small tools should be evident when we consider just what part the tools play in production. It is not the slightest advantage to have ultra high-speed automatic machines if the box-tool cutters, for example, fail after a short period of use. Production may go up temporarily, but so does the setting time, and ultimately there may be an increase in the production costs. The faster the speeds of the machines and the heavier the feeds, the better should be the steel used for the cutters. To neglect either the machine or the tools, is to risk losing the advantages offered by both.

In the case of reamers, for instance, two kinds should be sent to the shop at the same time for a comparative test. Depths, feeds, time, power required, and all other factors should be carefully noted. The results of tests made in this way will often be surprising. Naturally, the best tool for one purpose may not be the best for another. For instance, the make of drill best suited for use on an automatic screw machine may not be so satisfactory for use in a drill press. Perhaps some readers will view the foregoing remarks as being in the nature of splitting hairs, but to prove that such is not the case, it is suggested that they test some of their standard tools.

Carefully Made Tests of Cutting Tools will be Found Worthwhile

The proper test of the various makes of cutting tools will naturally involve some expense, but the increase in efficiency which will be realized when the best tool for each job is found will more than even up this expense. As a result of tests and experience, the writer has made up lists of tools for various classes of work which have proved very valuable.

It would doubtless be a great benefit to manufacturers to have some disinterested concern test the various tools available on the market and make lists showing the class of work for which each proved best adapted. It should be possible to grade the different types of tools in a manner similar to that used for government steels, and require each manufacturer to guarantee his product to meet a definite standard. If this were done, it would enable the manufacturer to quickly and intelligently decide on what grade or type of tools to select for each job.

Fixtures Operated by Compressed Air

Second of Two Articles on Pneumatically Operated Fixtures and Devices

By B. J. STERN

IN the first installment of this article, published in April MACHINERY, the author dealt with the general principles involved in air-operated equipment, describing valves used for controlling air-operated fixtures, a fixture for counterboring operations, and an air-operated chuck. In this installment will be described an air-operated stamping press, a milling fixture actuated by compressed air, and an air-adjusted semi-automatic machine which is unusual in that the different functions are performed without the use of a single cam, the various movements of the machine being controlled through the medium of compressed air.

Air-operated Stamping Press

In Fig. 6 is shown an air-operated stamping press which is designed to exert considerable pressure. The work is the cover of a registering device for a water meter which is required to be stamped with the serial number of the meter. The press shown in the illustration has replaced various devices that failed to give the sharp and deep impressions desired.

The piston transmits pressure to the stamping punch *G* through the toggle levers *D*. As the cylinder has an inside diameter of 12 inches, the pressure available is approximately 7900 pounds, employing an air pressure of 70 pounds per square inch. The upper end of the toggle joint is fixed in block *E*, while the other end is pinned to a slide *F* fitted in the casting *B*.

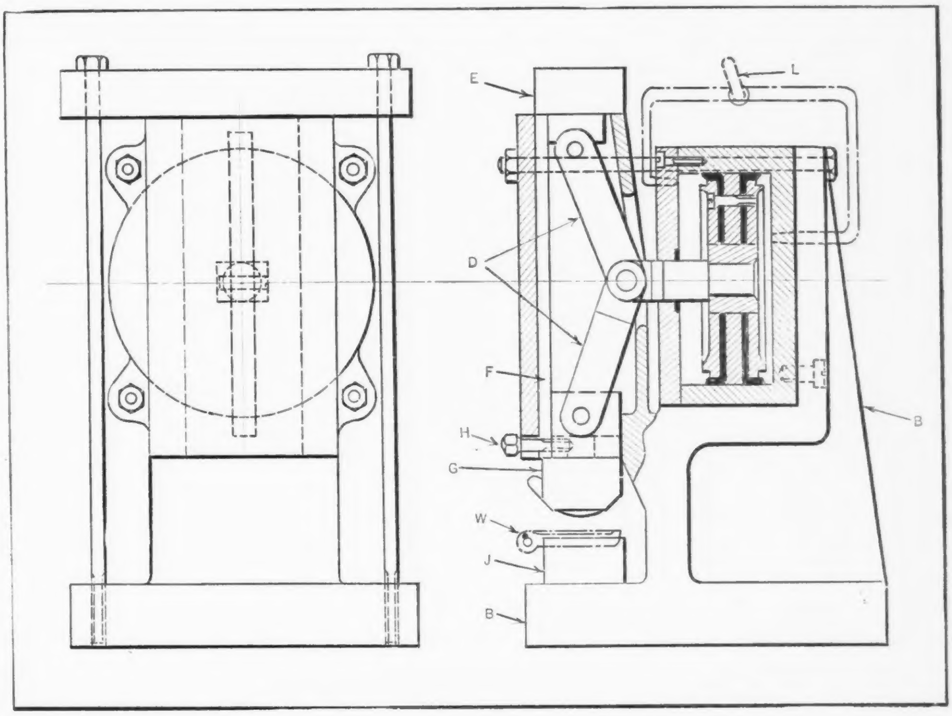


Fig. 6. Pneumatically Operated Stamping Press

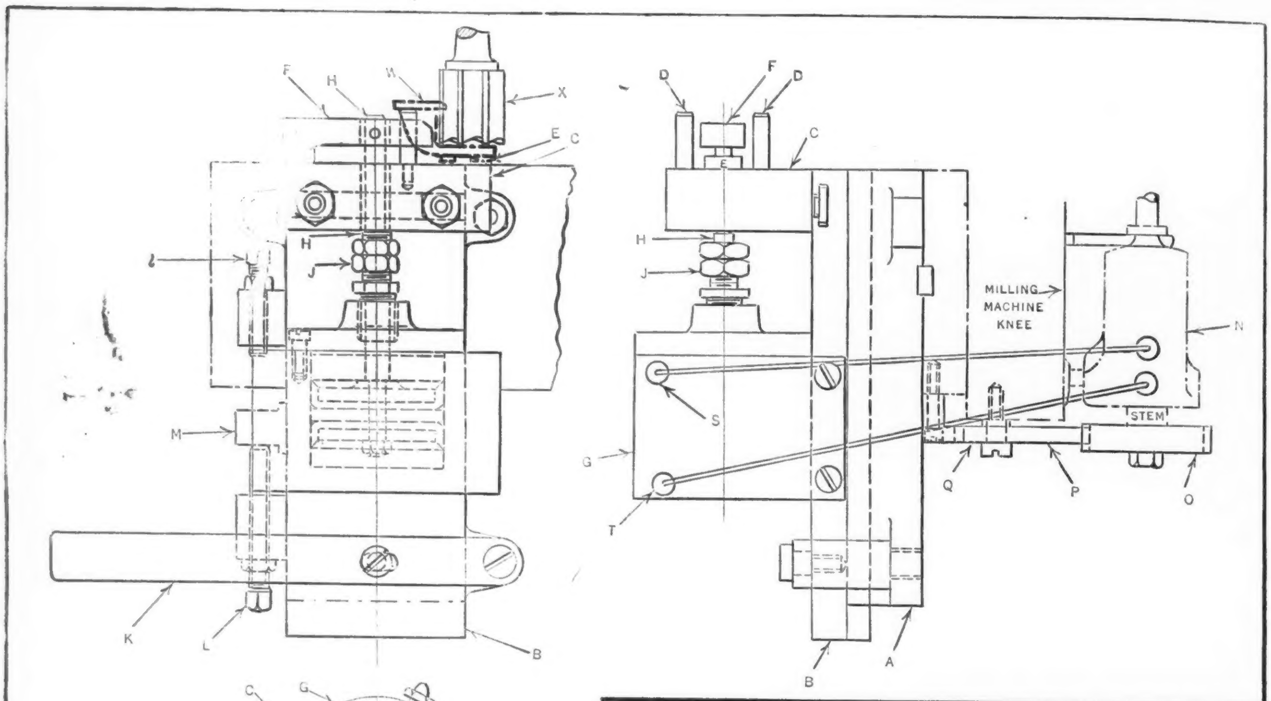
The shank of a commercial numbering mechanism *G* is clamped to the end of the slide by means of a screw *H*. The work *W*, shown in dot-and-dash lines, is held in a fixture *J* on the base of the casting *B*. Tie-rods are employed to brace or reinforce the press. The admission of air to the cylinder is governed by a commercial hand valve *L*.

Milling Fixture Actuated by Compressed Air

A milling fixture in which the work is clamped and unclamped automatically by means of air-operated pistons is shown in Fig. 7. The work to be milled is a rather complicated brass casting, shown by the heavy dot-and-dash lines at *W*. Two facing cuts are required to be taken at different levels by the cutter *X*. The milling fixture is mounted on one end of the table of a hand milling machine. The base *A* is clamped to the machine table, and the slide *B* moves back and forth in the dovetail slot in base *A*. A steel block *C* is keyed and clamped to slide *B*. The casting to be milled is placed on three pins *D* and *E*. The clamp *F* projects slightly through an opening in the work, and serves to force the work down on the three supporting pins.

An air cylinder *G* is mounted on a slide *B* directly behind the block *C*. The piston-rod *H* of this cylinder passes through block *C* and is pinned to the clamp. Check-nuts *J* are so arranged on the piston-rod that they strike against the block *C*, and in this way, limit the travel of the clamp when it is released. Slide *B* is moved in and out by handle *K*, the travel of which is limited by the adjustable stops *L* and *l*, which strike against the projection *M* on the base casting *A*. These stops are set to give the correct distance between the two surfaces milled by the cutter *X*.

Perhaps the most interesting feature of this fixture is the method of controlling the air which actuates the piston in cylinder *G*. A disk valve *N*, of the type used in the equipment shown in Fig. 5 in the first installment of this article (see April MACHINERY), is mounted on the knee of the milling machine directly below the fixture. A gear *O* is secured to the stem of valve *N*. When the gear *O* is turned in one direction, air is permitted to flow



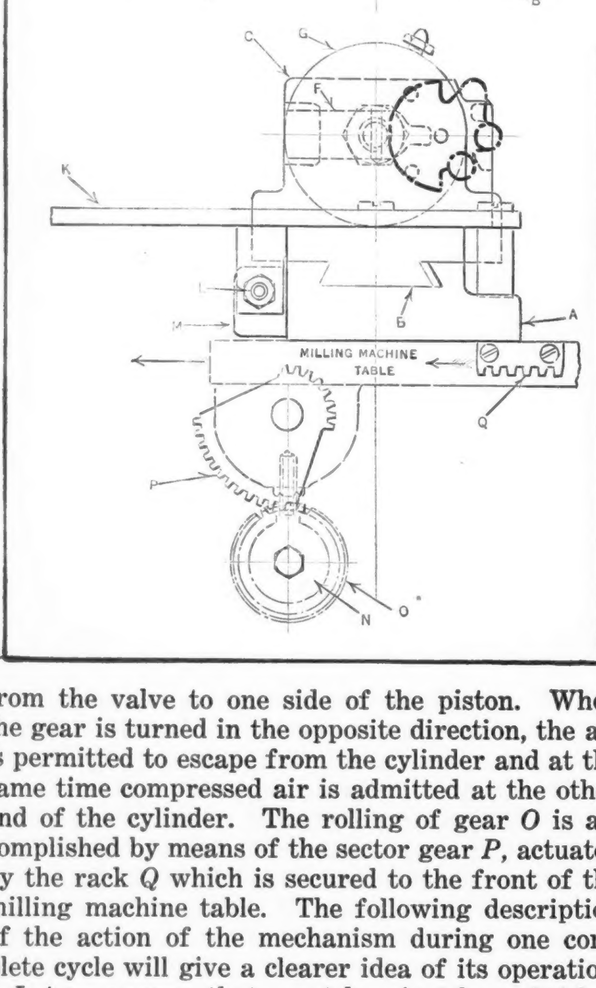


Fig. 7. Milling Fixture Provided with Air-operated Clamp

from the valve to one side of the piston. When the gear is turned in the opposite direction, the air is permitted to escape from the cylinder and at the same time compressed air is admitted at the other end of the cylinder. The rolling of gear *O* is accomplished by means of the sector gear *P*, actuated by the rack *Q* which is secured to the front of the milling machine table. The following description of the action of the mechanism during one complete cycle will give a clearer idea of its operation.

Let us assume that a cut has just been finished and the operator has moved the table back as far from the cutter *X* as possible. In moving the table back, rack *Q* serves to move the sector gear *P*, which, in turn, rolls the gear *O*. This movement actuates the valve disk, allowing air to enter the cylinder at port *T* and at the same time permitting air to be exhausted from port *S*, thus raising the clamp from the work. The work is then removed and another piece placed in position on the locating pins *D* and *E*, after which the table is moved toward the cutter. This movement rolls the valve gear in the opposite direction, causing air to be exhausted through port *T* and permitting air to enter port *S*. The piston is thus forced down, so that the clamp *F* holds the work securely in place.

While this is taking place, the operator moves the handle *K* in, so that stop *L*, on the slide, strikes the projection *M*. This locates the slide in the proper position for machining the inner face of the work casting. The feed of the table with the slide in this position continues until the table strikes a stop which is not shown in the illustration. The operator then moves slide *B* out until it clears this obstruction, and the stop *l* comes in contact with the projection *M*, which locates the slide in the proper position for milling the outer surface. The finishing of this cut completes the cycle of operations.

Air-adjusted Semi-automatic Machine

The semi-automatic machine shown in Fig. 8 will give some idea of the extent to which pneumatically operated mechanisms have been developed. This automatic machine is unusual in that the various functions are performed without the use of a single cam, the various movements all being controlled by compressed air. The work performed on this machine is the assembling of the monel metal roller *A* on the steel shaft *B*. The operations of driving roller *A* on shaft *B* and then burnishing the roller to give it a highly polished appearance are accomplished automatically by the machine.

The indexing block *C* has three stations, numbered 1, 2, and 3, which are spaced 120 degrees apart. Each station consists of a casing *D* which is screwed into the block, a split chuck *E* having a taper fit in the upper part of the casing, and a bushing *F* driven into the bottom of casing *D*, which holds the chuck in place. The work is loaded at station 1, where the chuck is open and permits the operator to drop a shaft *B* into place with its end resting on plug *G*. The monel metal roller is then placed in the nest on the top of casing *D*.

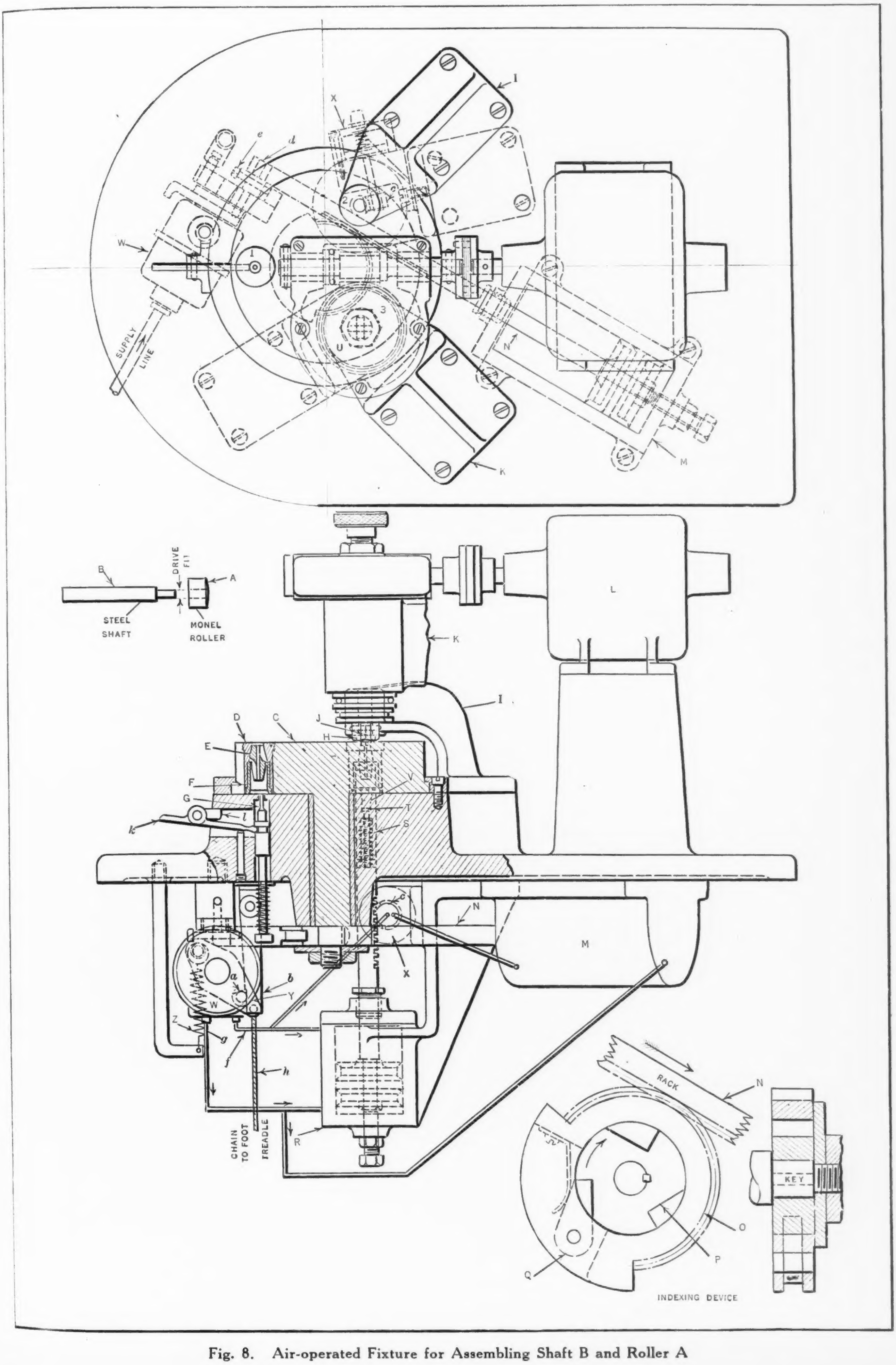


Fig. 8. Air-operated Fixture for Assembling Shaft B and Roller A

At station 2 the forcing operation takes place, the driving being done against a hardened anvil block *H* held in the bracket *I* which is fastened to the base directly over station 2. At station 3 the burnishing operation is accomplished by the rollers *J*, which thrust against bearings in the bracket *K*. The burnishing rollers are driven by the motor *L* which is fastened to a pedestal on the base, the driving being done through a worm and gear. The rollers are run at a speed of about 240 R.P.M.

On the under side of the base are attached three air cylinders, one for indexing the block *C*, the second for providing the pressure required for assembling the shaft and roller, and the third for holding the assembled roller against the action of the burnishing rollers. The indexing cylinder *M* drives a piston-rod *N* in which rack teeth are cut that actuate the indexing device shown in the view in the lower right-hand corner of the illustration. It is evident that the rack, being drawn back and forth by the action of the air in cylinder *M*, will roll the segment gear *O* in both a clockwise and anti-clockwise direction.

Since the stations are indexed only in a clockwise direction, this anti-clockwise or recovery stroke must be taken care of. This is done by the ratchet *P* and pawl *Q*. The pawl, being attached to the segment gear, will roll with it when it is actuated by the indexing stroke of the piston-rod, and striking the ratchet, will cause the latter part to turn the shank of the indexing block the proper distance for indexing the station. At the recovery stroke, however, the pawl, moving anti-clockwise, will slide over the top of the indexing ratchet until the end of the stroke is reached.

Under station 2 is the cylinder *R*. This cylinder actuates the piston-rod to which is attached the locating spring plug *S*. When the stations are indexed around, this plug, being forced up by the air in cylinder *R* will enter the indexing hole in the block *C*, locking the block in place. The piston top *T*, continuing to rise, strikes the shaft being assembled and drives it through the monel metal roller. The continued pressure forces the roller against the anvil *H*, while the stem of the shaft is slightly headed over against the anvil block. At this point, the piston-rod ceases to rise and drops back. Attached to the bracket of cylinder *R* is the distributing disk valve *X*, which is actuated by a rack cut in the piston-rod *S* of cylinder *R*. The action of this valve will be described later.

Simultaneously with the action of the cylinder of station 2, occurs the movement of the piston in the cylinder at station 3, which is an exact duplicate of the one at station 2. As the piston-rod *S* rises, the piston-rod of the cylinder at station 3 also rises, causing the plug *V* at its head to enter the hole in bushing *F*. Plug *V* contains a tapered hole that corresponds to the tapered plug of the split chuck *E*, and thus raises the split chuck *E* and forces it into the taper in casing *D*. This causes the chuck to grip the shaft of the assembled roller while the latter is being burnished by the rollers at station 3.

The functions of the three cylinders having been outlined, the methods of controlling the various operations will next be considered. It is the valving of the compressed air, of course, that controls the working of the pistons in the cylinders. Under the base at a convenient point is placed a disk valve *W*. To this valve is piped the supply line which is distributed to two outlet pipes. Branch pipes run from these outlets, one branch running to the tops of cylinders *R* and *U* and also to the distributing valve *X*. The other outlet branch pipe runs to the bottoms of cylinders *R* and *U* and also to the back of the indexing cylinder *M*. This leaves only the front of cylinder *M* to be taken care of, and this is done by a pipe line from distributing valve *X*. The action of the main valve *W* is controlled by the lever *Y* on the front of the valve.

Attached to lever *Y* is a chain controlled by a foot-treadle. As this chain is pulled down, the lever is forced around against the action of a stiff spring *Z* until the pin *a* in the lever is caught and held by the latch *b*. This causes air to flow through the outlet pipes to the tops of the cylinders *R* and *U* and to the distributing valve *X*. It is then evident that the piston-rods of cylinders *R* and *U* will drop back from the block *C*. When the piston-rod of cylinder *R* reaches the bottom of its stroke, it will have rolled the gear *c* on the distributing valve *X* far enough to allow air to enter the front of cylinder *M*, thus causing the indexing piston-rod to begin its movement.

It is clear that this movement cannot begin until the piston-rods of cylinders *R* and *U* have cleared the bottom of the indexing block. This is the reason that the distributing valve *X* is used. The indexing piston then completes its stroke, moving the stations around until the adjustable set-screw *e* in bracket *d* at the end of rod *N* strikes latch *b* and forces it away from pin *a*, thus allowing spring *Z* to pull lever *Y* back. This shuts off the flow of air from outlet *f* and diverts it to outlet *g*, which is piped to the bottoms of cylinders *R* and *U* and to the back of cylinder *M*. The piston-rods of cylinders *R* and *U*, therefore, rise, while the indexing piston-rod *N* goes through its recovery stroke, thus completing the cycle. To begin this cycle over again, it is necessary for the operator to pull the chain *h* down.

There still remains the problem of removing the completed assembly after it leaves the burnishing station 3 and before it arrives at the loading station 1. At first a blast of air was used to blow out the assembled part before it arrived at the loading station. This, however, did not prove a very dependable device, as the chuck *E* sometimes retained its grip around the shaft. It was, therefore, necessary to provide means for mechanically removing the assembled shaft and roller. This was done by placing a finger-trip *k* in a bracket *l* at the loading station. By pushing down on this trip, the operator can raise plug *G* and thus force the work out to make way for reloading.

* * *

According to information obtained by the Bureau of Foreign and Domestic Commerce, Washington, D. C., the Swedish mechanical industries progressed considerably during the past year. Exports in the machinery field increased from $28,730,000 in 1925 to $34,625,000 in 1926.

Notes and Comment on Engineering Topics

Two of the largest synchronous motors in the world are to be installed by the Bethlehem Steel Co. in the company's new continuous skelp and sheet bar mill at its Sparrows Point plant near Baltimore, Md. These are General Electric motors rated at 4000 and 6500 horsepower, respectively. They are said to be the largest ever built for main-roll drive, with the exception of the 9000-horsepower General Electric motor in the River Furnace plant of the McKinney Steel Co. at Cleveland, Ohio.

An appropriation of $78,000 for the completion of an aeronautical laboratory and for the establishment of the Daniel Guggenheim Professorship of Applied Aeronautics at the University of Michigan, Ann Arbor, Mich., has been authorized by the members of the Daniel Guggenheim Fund for the Promotion of Aeronautics. Of the appropriation, $28,000 will be used to complete laboratory apparatus and to construct new testing and research instruments. The remainder of the appropriation will be paid in installments of $5000 a year over a period of ten years for the establishment of the professorship.

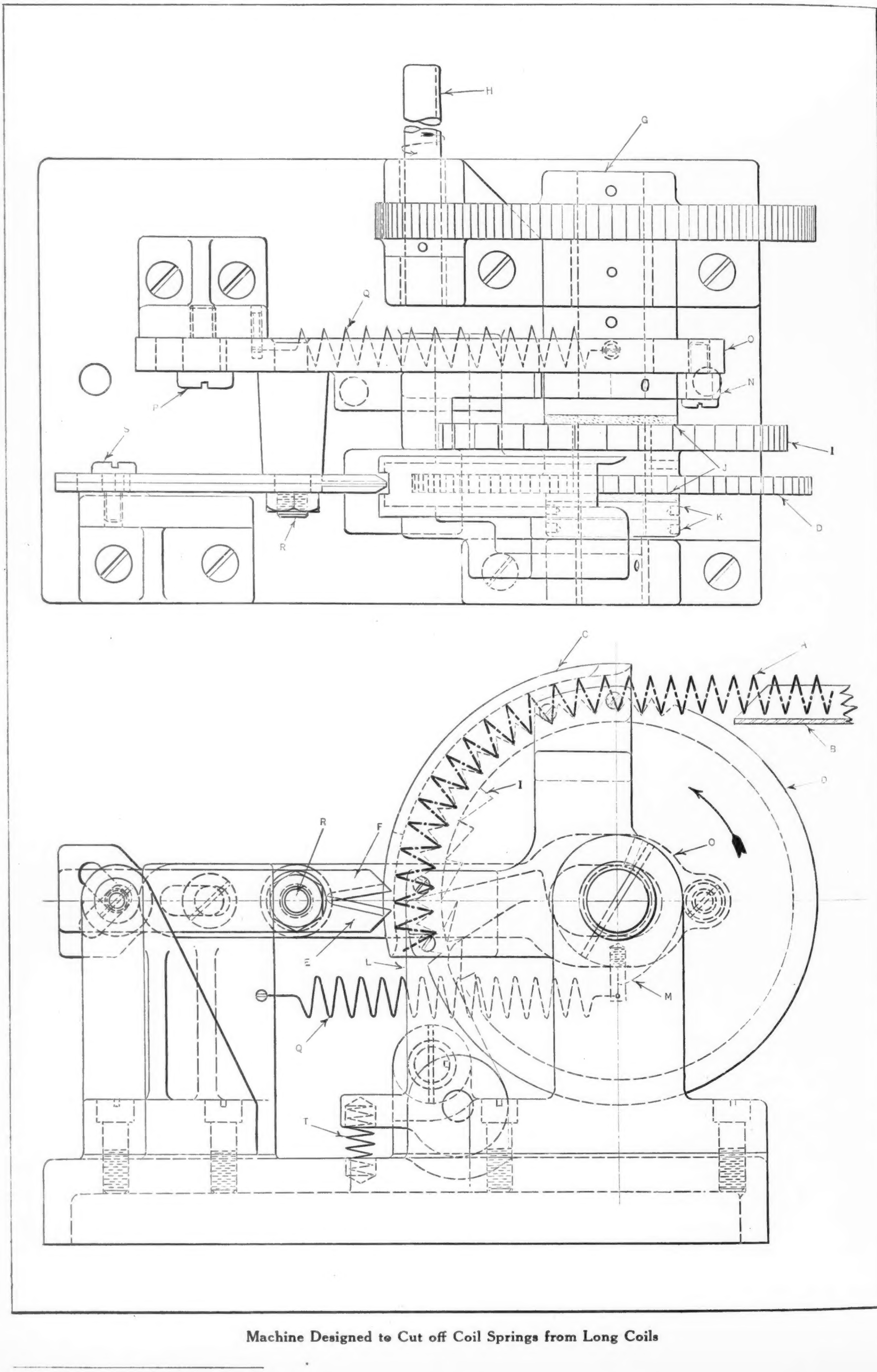
It is mentioned in the *Compressed Air Magazine* that a German chemist, Fritz von Behr, has developed a process for coloring wood while it is growing in the forest. He is said to have transformed beech into "rosewood" and yellow birch into "mahogany" so perfectly as to puzzle even lumber experts. The flowing sap is charged with coloring matter that is thus distributed uniformly throughout the body of the growing trees. The pigment does not injure the fiber; on the contrary, it has been found to act as a preservative. The change in color is effected in a few days, but the results are permanent.

Some interesting and at the same time startling figures have been compiled by George D. Kohler, an engineer on the Reading Railroad, in connection with the efforts exerted by the man at the throttle and the fireman in making a run from Philadelphia to Pottsville and return. On that 200-mile trip they perform 5123 individual acts, which are divided up as follows: steam throttle is operated 928 times; whistle, 268; brake valve, 90; blower valve, 1100; air fire door, 945; bell ringer, 200; sand leech, 80; right injector, 700; left injector, 30; water-gage tests, 30; and equalizing brake and discharge valve, 752.

Since the adoption of illuminating gas to replace acetylene, hydrogen, and other gases for metal cutting, the General Electric Co. has found many valuable uses for this new metal cutting medium at its various plants. As an example, risers are cut from steel castings with oxy-illuminating gas torches, a 19-inch steel riser being cut through in 7 1/2 minutes. The new method reduces gas costs, as illuminating gas is cheaper than either hydrogen or acetylene. The principal advantages claimed are (1) availability; (2) elimination of delays and handling of tanks; (3) low cost; (4) safety; and (5) chemical and physical properties permitting the use of the gas in a torch equipped with a superheater, thus effecting marked economies in the amount of oxygen required by the cutting jet.

A survey of wage payment methods, covering forty industries, has been made by the Technical and Industrial Research Division of the Sherman Corporation, Boston, Mass. This survey shows that the number of employes paid by the newer incentive forms of wage payment, such as the individual or group bonus methods, is only about 8 per cent. It is significant, however, that the automotive industry leads in the percentage of workers on a premium or bonus system, there being 65 per cent under some such wage payment plan. The general average for all of the forty industries surveyed showed that 61 per cent of the employes are on a straight time basis, 31 per cent on a piece rate basis, and 8 per cent on a premium or bonus basis. In the machinery industry, the corresponding percentages are 68 per cent, 18 per cent, and 14 per cent, respectively. In the automotive industry, the percentages are 17, 18, and 65, respectively. Over a half million employes are represented in these findings, and it will be noted that the figures represent percentages of employes and not percentages of plants.

At the recent International Coal Conference at Pittsburg, Dr. Bergius of Heidelberg, Germany, described a method whereby coal can be practically liquefied and changed into fuel oil. In this process, coal is ground to pass a twelve-mesh (or finer) sieve, and is then mixed with the heavy portion of the oil derived from the previous operation of the process. The resulting pasty material is forced into a container, where it is heated, together with the oil already placed in the container, under a pressure of approximately 3000 pounds per square inch. Hydrogen is also introduced with the coal and oil. When the products are withdrawn, the gases, liquids, and solid materials are separated, and about half the weight of the coal charged appears in the form of oil; or in other words, one net ton of coal will yield approximately 130 gallons of oil. By a somewhat different treatment, a ton of coal will produce 45 gallons of gasoline of high quality. Good lubricating oils can also be derived from this process. It is said that two plants based on this process are being built in Germany, having a capacity of 1,000,000 barrels of oil a year.



Machine Designed to Cut off Coil Springs from Long Coils

Machine for Cutting off Coil Springs

By JOSEPH FENNO

THE writer was recently confronted with the problem of providing a machine for cutting off springs from coils previously wound in a speed lathe with a special tool. The coils had an outside diameter of 9/16 inch and were wound with a lead of 5/16 inch from wire 0.034 inch in diameter. The springs cut off from these coils were required to have two turns.

Although a large quantity of these springs was to be made, it was not deemed advisable to purchase a standard spring machine, as no repeat orders were expected. The machine shown in the illustration was therefore constructed. It is now in satisfactory operation cutting off 3000 springs per hour.

Referring to the illustration, the coil *A* to be cut off is fed from the tray *B* by the operator, being started into the machine by dropping the end through the space or notch cut in the top of guard *C*. When the end of the coil is dropped through the notch, it rests on the carrier wheel *D*, which has notches cut in its periphery to suit the spacing or pitch of the coils. Carrier *D* is indexed around in the direction indicated by the arrow, and at each position, the shears *E* and *F* advance through a slot in guard *C* and cut off a spring, which drops through an opening in the machine base into a box.

The continuous indexing and cutting off of the springs is accomplished in the following manner: The pinion on shaft *H*, meshing with the gear on shaft *G*, serves to drive the latter shaft continuously in the direction indicated by the arrow in the lower view. Integral with carrier *D* is a ratchet *I*, the teeth of which are spaced to index the work-carrier two spaces or teeth at a time.

The work-carrier is a running fit on the shaft *G*, and is driven by the friction disks *J*, one of which is backed up by a shoulder on shaft *G*, and the other by the spanner wrench collars *K*, which can be adjusted to give the required driving pressure. This construction permits the carrier and ratchet to be held stationary by the pawl lever *L* while the shaft *G* continues to rotate.

Secured to shaft *G* is a cam *M*, and in contact with this cam, is a roller *N* mounted on bar *O*. Bar *O* has slots at each end which are sliding fits over the stud *P* and the shaft *G*, respectively. A spring *Q*, attached to bar *O*, serves to keep the roller *N* in contact with the cam *M*. As cam *M* continues to revolve, it causes bar *O* to slide to the right. This action also causes the shear blades *E* and *F*, which are pivoted on stud *R*, to advance through the opening in the guard *C* and cut off the spring. The closing movement of the shears required to cut off the spring is obtained by means of cam slots in the rear ends of the blades, which fit over a fixed hardened steel stud *S*. These slots are cut at an angle, which causes the blades to pivot on stud *R* and shear the spring when the blades are advanced.

As cam *M* continues to rotate after the spring is cut off, roller *N* drops back over the heel of the raised portion of the cam, permitting bar *O* to slide to the left under the action of spring *Q*, and withdraw the shear blades. The continued rotation of cam *M* brings the raised portion into contact with the pawl lever *L*, causing it to release the ratchet *I* and permit the carrier *D* to revolve with shaft *G* until the pawl, actuated by spring *T*, catches the next tooth and prevents the carrier from turning again until the cycle of operations has been repeated and another spring cut off.

J. E. FENNO was born in Fitchburg, Mass., in 1896. After graduating from the Fitchburg High School, he became apprenticed to Manning, Maxwell & Moore, Inc., working for three years in their Fitchburg shop, after which he became a toolmaker with the Cowdrey Machine Co. in the same city. Two years later he became associated with the Simonds Saw & Steel Co. of Fitchburg, where he was in charge of machinery repairs. He then studied drafting and obtained a position with the Fitchburg Paper Co., working on improvements and developments on paper mill machinery. Two years later he entered the employ of the Bryant Electric Co., where he designed machinery and tools and supervised their building for a period of three years. Since 1925 he has been tool engineer with the Nash Engineering Co., South Norwalk, Conn.

* * *

RESEARCH WORK IN ENGINEERING COLLEGES

About fifty American engineering colleges are carrying on organized engineering research. Fifteen of these receive annually more than $500,000 for research through cooperative relations with industry. The total annual expenditure by engineering colleges for research is more than $1,000,000. The cooperative relations between Purdue University and the American Railway Association have resulted in extensive studies, for which the association has appropriated more than $500,000 during the last two years.

These statements were made in an address at the annual meeting of the Society of Automotive Engineers by Professor G. A. Young, head of the School of Mechanical Engineering of Purdue University, who asserted that research work carried on by universities has several advantages over that done in industrial laboratories. The workers are free from interruptions, are in an atmosphere that is sympathetic to research, and their work reacts most beneficially in improving the students.

If industry will take its problems to the universities, as is done in Germany, it will be able to secure engineers who will increase the fund of knowledge and develop new processes for the conservation of our resources and for the elimination of waste. Leaders of industry are convinced that research laboratories must be used to acquire new and exact knowledge of facts, to develop new products, and to lower manufacturing costs.

What MACHINERY'S Readers Think

Contributions of General Interest are Solicited and Paid for

STIMULATING INTEREST IN SHOP WORK

It has been my observation that the average apprentice in the machine shop often loses interest in his trade when he has served his allotted apprenticeship. When he first comes into the shop, he is interested in everything that is going on, but later on he appears to have no interest in anything beyond his own particular machine or work.

Who is at fault? Sometimes the man himself, because, unfortunately, there are many in the position of being square pegs in round holes; but often I believe that the men in charge are at fault by not taking the human side of the men sufficiently into account, and by dealing with the employes as if they were mere machines. It seems to me that there is not the same opportunity for a man to exercise his latent abilities in most shops that there used to be in the old-time machine shops, out of which so many capable mechanics and machine designers came. A little recognition and stimulation of interest would arouse the dormant abilities of many men and make them more valuable workers.

It seems to me that shop executives—particularly those who are in direct contact with the rank and file—are in a position to foster and excite in the younger men an interest in the results obtained, by giving them a chance to use their own imagination and ability. There are just as many bright young fellows in the trade today as there ever were, but in the highly systematized shop in which they largely cease to be individuals, they become apathetic. I am wondering whether this is not due to the lack of interest shown in them and the failure to take advantage of their ability and enthusiasm. H. W. MORLEY

* * *

GETTING ALONG WITH MEN

Apart from his ability in doing the work assigned to him, the greatest asset that a man can have in any walk of life, and certainly in the factory as much as anywhere else, is his ability to get along with other men. Indeed, this quality is often worth more than a detailed knowledge of the actual work to be done. A foreman, for example, who can get along well with his men will be more successful in turning out work, even though he may not be an expert machinist, than one who may be the best machinist in the world but who is unable to retain the good will of his men. A man who can create a contented atmosphere in his department or in his plant has reduced costs tremendously by that one fact alone. In the first place, he has reduced labor turnover, and labor turnover is costly. When one man leaves and another man is hired, you can figure on a loss of anywhere from $25 to $100. Furthermore, men that are happy at their work perform more and better work than those that are busy nursing a grudge.

The manager of a fair-sized plant believed that if you could start men at work in the morning with a happy feeling, it would mean a great deal to the day's output. Working on this theory, he had a witty Irishman as a watchman at the door. This man knew everybody in the shop by his first name or his nickname, and was friendly with everybody. He kept up a continual line of conversation with the employes greeting them as they entered the plant. He generally created a good many laughs, and as the manager said, "If you can get men to laugh when they go to work you can be sure that they will work better than if they carry a grouch."

Men who have such an understanding of human nature are usually successful managers, because, after all, the biggest problem of management is the problem of handling men. J. S. G.

* * *

THE SALESMAN—A CONSULTING PRODUCTION ENGINEER

The qualifications for successful salesmen in the engineering field are constantly growing more and more exacting. To sell machine tools and other types of machinery successfully today, a salesman must not only be able to present his case to the prospective customer in an attractive manner, but must also be thoroughly familiar with the mechanical principles of the machines he is selling, so that he can answer almost every question that may be raised. Besides, he must have a broad knowledge of competing equipment.

The time passed long ago when a lathe was merely a lathe, and a planer just a planer. Today the salesman must be able to demonstrate definitely the reasons why the machine he represents is superior to other machines on the market. He must be able to go into the customer's shop and determine from the conditions he sees there whether his machine possesses advantages that can be easily demonstrated. He must be able to pick up the product being made, and to determine whether or not his machine is particularly adapted for the work to be performed. He must be able to "spot" inefficient or unsuitable methods, and to propose other means for performing the same work more advantageously by the equipment that he has to sell. In other words, in addition to being a salesman, he should really be a consulting production engineer. E. V.

* * *

The standards committee of the Society of Automotive Engineers this year consists of 225 members grouped into twenty-two divisions. From time to time the council of the society assigns to the divisions subjects for standardization that fall within the jurisdiction of each group. In addition, in many instances, sub-divisions are organized to report on a specific subject.

Designing Stampings or Die-made Parts

Direction of Grain Stock—Length of Material for Forming Lugs—Hub Embossing and Clinched Lug Fastenings

By J. K. OLSEN, Chief Draftsman, Stewart-Warner Speedometer Corporation, Chicago, Ill.

In many lines of manufacture, castings have been replaced by die-made parts, and frequently the older designs of sheet-metal parts have been replaced with lighter designs in which thinner stock is made sufficiently strong and rigid by forming or embossing reinforcing ridges or curved sections. Die-made products, owing to their low cost and uniformity, are preferable to castings, assuming that the quantity is large enough to justify the investment in the necessary die equipment.

Some miscellaneous examples of stampings or punched parts have been selected in order to illustrate a number of important features and methods of procedure which both designers and diemakers should know about. Although it is not feasible in this article to do more than offer some hints and suggestions, the few examples selected from the endless variety found in practice are intended to illustrate certain important general principles in such a way that these principles can be applied to various other similar classes of work.

Direction of Grain of Stock

In the production of metal stampings, it frequently is important to consider the relation between the grain of the material and the shape or function of the part to be produced. This is especially true in regard to springs, such as contact springs, or punched parts that serve a similar purpose. For work of this class, the grain of the stock

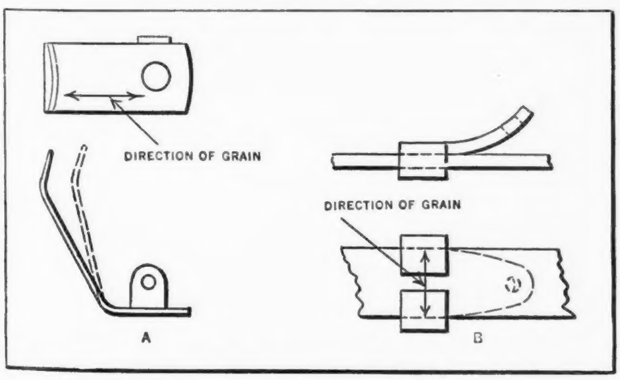


Fig. 1. Relation between Direction of Grain of Stock and Design of Stamping is Important for Parts Similar to Examples Shown

should extend in a lengthwise direction, as indicated at *A*, Fig. 1, so that the bending action is across the grain and not parallel to it.

The illustration *B*, Fig. 1, shows another example in which the direction of grain is important and should be specified on the drawing. In this case, one sheet-metal part is attached to another by crimping lugs that are bent around to serve as a fastening means. The grain of the stock extends lengthwise of the lugs so that the bending is across the grain. A specification of this kind is important when the stock is relatively hard, because if an attempt were made to bend the lugs parallel to the grain, they probably would break; moreover the

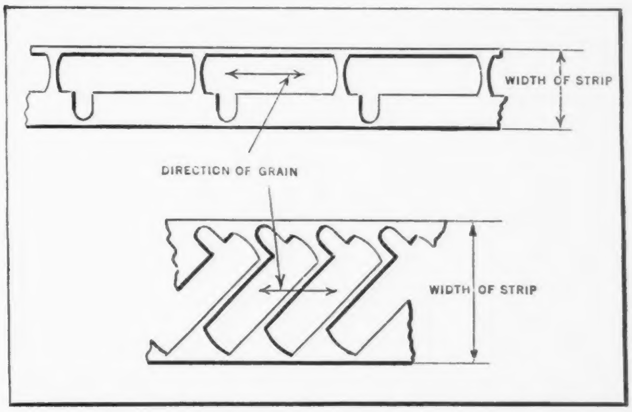


Fig. 2. Upper Lay-out Wasteful of Stock but Required to Obtain Lengthwise Direction of Grain

lugs are stronger when their relation to the grain direction is as shown.

With the exception of springs or special bending operations of the kind just referred to, the direction of the grain of the stock should not be specified, because this may require a decided increase in the amount of stock needed to produce a given number of parts. This is illustrated in Fig. 2. The upper lay-out shows how the blanks for springs *A*, Fig. 1, are cut from a strip in order to have the grain extend in a lengthwise direction. . The layout below shows how the blanks might be laid out if this grain requirement were not necessary, the blanks being staggered in the usual way to avoid as much waste stock as possible. In this instance, the upper lay-out would require about 20 per cent more stock than the lower one, so that it is evident that specifications regarding direction of grain should not be made unless this is necessary for special classes of work on account of the reasons previously mentioned.

Amount of Stock Required for Bends or Lugs

When bends or lugs are formed in a die, the designer, in certain cases, must estimate the length of stock required to form the curved lug or other part, especially if the stock is obtained from some section of the piece of which the lug is part. An example of work is shown at the left in Fig. 3, the two mounting lugs being sheared and formed out of the central part of a circular stamping. The problem is to determine the developed length, or the length of straight stock that will form a lug

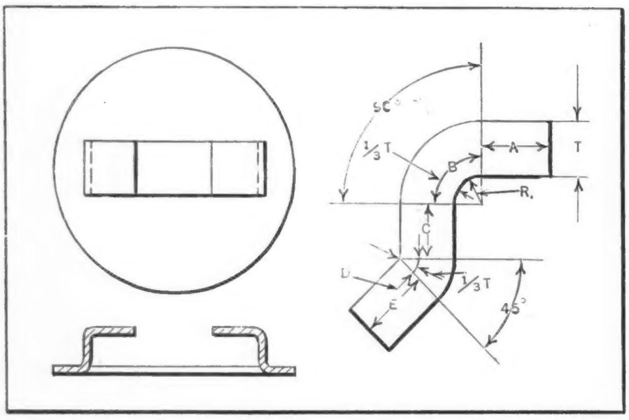


Fig. 3. Stamping Having Raised Clinching Lugs—Diagram at Right Shows Method of Determining Stock Allowance to Form Lugs

having, in this instance, a reverse curve. The diagram at the right in Fig. 3 illustrates the procedure.

The amount of straight stock to allow for forming a 90-degree curve is equal to the length B of an arc, the radius of which is equal to the inside radius R of the bend plus one-third the stock thickness. For example, if the stock thickness is 0.1875 inch and the inside radius R 0.250 inch, then the radius of arc B would be $0.1875 \div 3 + 0.250 = 0.3125$ inch; hence, the length of this arc would equal one-fourth the circumference of a circle having a diameter of 0.625 inch. Therefore, the allowance for this bend would be 0.490 inch approximately.

The method of determining the allowance for a 90-degree bend may be expressed by the following rule. To determine the allowance, add to the inside radius one-third the stock thickness and multiply the sum by 1.5708. If the stock has a 45-degree bend, as shown at the lower part of the diagram, then the inner radius might be too small to take into account.

To obtain the total length of flat stock, the straight sections A, C, and E are, of course, merely added to the allowance for the curved parts as determined by the foregoing rule. It is advisable to check this calculated length by making a large layout (ten to one scale) and actually measuring the length by "stepping off" the distances, using dividers set close enough to minimize the errors.

Embossed Dowels and Hubs

When dowel-pins are required to insure the accurate location of parts relative to each other, small projections or bosses may be formed directly on many die-made products, the projection being an integral part of the work and serving as a dowel-pin. Fig. 5 illustrates how the dowel is formed. The method may be described as a partial punching operation, as a punch penetrates about one-half the stock thickness and forces the boss into a pocket in the die which controls the diameter and compresses the metal, thus forming a stronger projection than would be obtained otherwise.

The depth A of the dowel or boss should not exceed one-half of the dowel diameter B and depth A should not exceed one-half of the stock thickness C. This is a practical rule which may be applied either to steel or non-ferrous metals, such as brass.

When sheet-metal parts must be held together by machine screws, if the stock is not thick enough to provide the necessary thread length, a common method of overcoming this difficulty is to form a hub integral with the part, by a drawing or embossing operation (see diagram A, Fig. 4). This hub is afterward tapped, and it provides a much stronger grip for the screw than would be obtained with a plain hole through the stock, owing to the increased number of threads.

To illustrate how the hub is proportioned, assume that a No. 8 (0.164 inch) machine screw of 32 pitch is to be used in conjunction with the lightest stock that is practicable for this thread. Since the thread depth for 32 pitch is 0.0203 inch, the minor or root diameter equals $0.1640 - 0.0203 \times 2 = 0.1234$ inch. For work of this kind, it is a general rule to allow for a thread depth of 66 to 75 per cent of the full depth. Assume that a clearance of 0.010 inch is allowed in this case; then the diameter of the hole in the hub equals the minor screw thread diameter, or $0.1234 + 0.010 = 0.1334$ inch. Since the nearest commercial punch size is 0.134 inch (Stub's steel wire gage), this size would be specified.

Now the stock thickness must be sufficient to include the major or outside diameter of the screw and leave enough margin to provide the necessary strength. If the material is steel and the part is not to withstand much strain, a wall thickness of, say, 0.015 inch would be satisfactory. Therefore, by adding double this allowance, or 0.030 inch, to the outside diameter of the screw, or 0.164 inch, we obtain the outside hub diameter, which in this instance is 0.194 inch. The difference between the outside and inside hub diameters is $0.194 - 0.134 = 0.060$ inch, and half of this difference, or 0.030 inch, is the desired stock thickness.

However, since this thickness does not conform to a standard gage size, we have to use either 0.028 or 0.032 inch thickness, as these dimensions conform to the Birmingham wire gage. The smaller thickness could be used for steel, but for brass or other non-ferrous metals it would be preferable to use the heavier material, as there are variations that should preferably be allowed for, unless the weight of stock is a very important consideration.

In determining the height of the drawn hub, it is common practice to provide for at least four full threads in the tapped hole, although sometimes there are good reasons why the depth of hub should

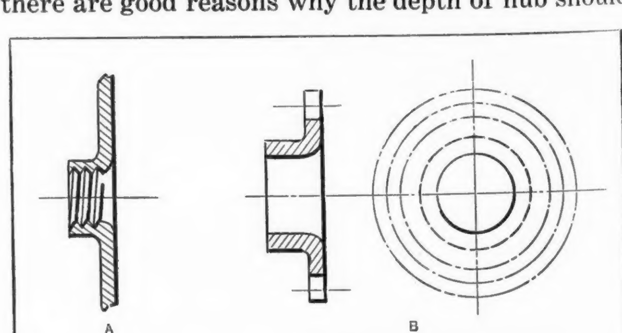


Fig. 4. (A) Drawn Hub which Provides Extra Thread Length in Tapped Hole; (B) Small Die-made Gear Having Drawn Hub

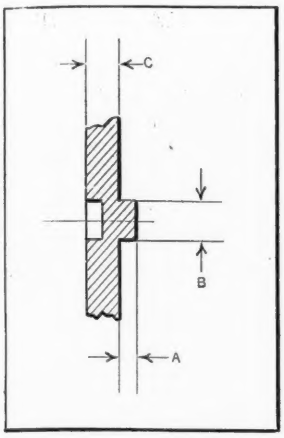


Fig. 5. Embossed Lug or Dowel Used to Align Assembled Parts

be sacrificed, thus reducing the effective thread length. This drawn or embossed hub can, as a general rule, be one-half as high as the hole diameter. Embossed hubs are not always practicable, especially if the holes are comparatively small and the threads relatively coarse. Large expensive stampings should not, as a rule, have too many tapped holes, because if the tapped thread should be stripped or otherwise spoiled, this might ruin the complete part; hence, it is preferable to use nuts for many of the more elaborate designs.

The formation of hubs by drawing or embossing may be used to advantage not only for tapped holes, but in connection with such parts as small pinions or gears that are cut from sheet stock in a die. An example of a small gear is shown at *B*, Fig. 4. In forming hubs of this kind, the stock, in many cases, will be made somewhat thinner, and this should be allowed for.

The exact method of forming a hub and the number of operations depend somewhat upon the relation between the depth of the hub, its diameter, and the stock thickness. A progressive die is generally used, especially if the production is large. Fig. 6 illustrates the successive operations in forming a small gear hub. Strip stock is used, and the sectional views from left to right indicate how the large embossing or indentation is gradually decreased in diameter and at the same time made deeper until finally the gear and its completed hub is blanked out, as indicated at the extreme right of the diagram.

A hub like the one shown at *A*, Fig. 4, is easier to produce, chiefly because it has less depth. The general procedure is to begin by perforating a small hole, which is afterward enlarged by a forming operation.

Clinched Lug Type of Fastening

A clinched lug type of fastening that eliminates tapping and the use of screws is illustrated in Fig. 7. This method of assembling sheet-metal parts may be used when the parts are to be assembled permanently. As the illustration shows, a lug on one part passes through a slot in the other member and is clinched over. This general type of fastening is largely used, because it is inexpensive and also provides an effective lock.

The width of the slot should equal the maximum stock thickness plus a slight clearance. If the stock is commercial strip steel 0.032 inch thick, and the stock has a plus or minus tolerance of 0.002 inch, then the slot should have a width of, say, 0.035 inch, thus providing 0.001 inch clearance. As the tolerance for the slot width should easily be held to 0.003 inch, the slot width would be $0.035 \begin{matrix} +0.003 \\ -0.000 \end{matrix}$ inch.

If a rigid assembly is desirable and the lug is also needed to serve as a dowel to secure uniform location between the parts, then the lug should fit the slot closely in a lengthwise direction. Assume that a slot 0.250 inch long will accommodate a lug having sufficient strength. As a minus tolerance of 0.002 inch should be satisfactory, we have $0.250 \begin{matrix} +0.000 \\ -0.002 \end{matrix}$ inch.

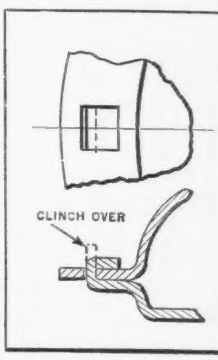


Fig. 7. Clinched Lug Type of Fastening

Since the minimum slot length is 0.248 inch, the lug should be made $0.248 \begin{matrix} +0.000 \\ -0.002 \end{matrix}$ inch. With these proportions, the difference between the maximum slot length, or 0.250 inch, and the minimum lug width, or 0.246 inch, equals 0.004 inch clearance, which is needed to provide a free assembly. This clearance, however, may be entirely eliminated, because in bending or clinching the lug, there is always a slight swelling of the stock on the outside of the bend, which would tend to fill the slot lengthwise. This swelling varies with the stock thickness, and for a thickness of 0.032 inch it probably would amount to enough to eliminate all play, except possibly when a lug of minimum width happened to be assembled in a slot of maximum length.

Minimum Diameter of a Punched Hole

The general practice is to punch holes in sheet stock only when the hole diameter is equal to or greater than the stock thickness. This rule is not always adhered to strictly, and the hole diameter may be as small as three-quarters of the stock thickness, but usually this necessitates replacing punches so often that it would be cheaper to drill the holes. However, the minimum size of a punched hole for a given stock thickness depends, in part, upon the hardness of the stock. Incidentally, if

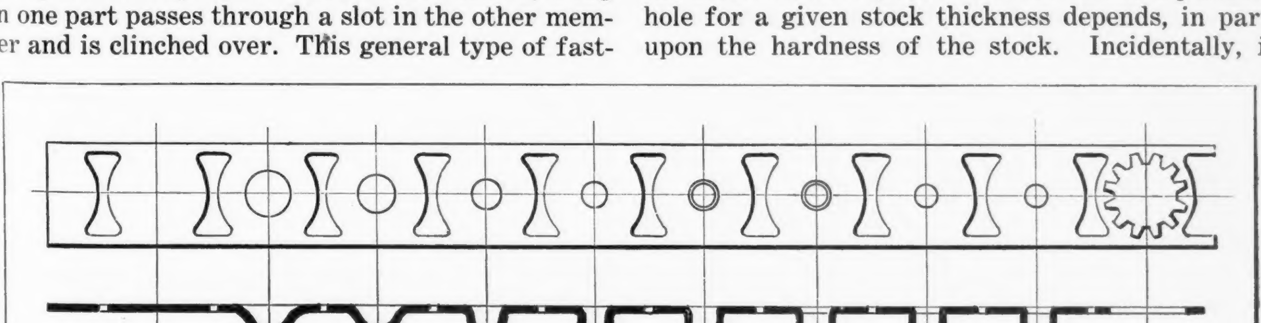


Fig. 6. Sequence of Operations in Forming Gear Hub

an unusually smooth accurate hole is required, a second shaving operation is employed.

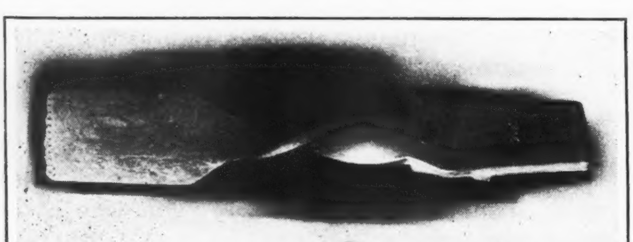
In all die-made products, holes should preferably be made to standard drill rod sizes (Stub's steel wire gage) or to fractional sizes for holes larger than the maximum drill rod size. The advantage in using Stub's steel wire gage sizes is that the punches may be made directly from commercial stock without grinding them to size.

If holes in different parts must be in alignment, it should be remembered that some variation will occur if the holes are not produced in the same die. This is particularly true if punched holes in one part must be aligned with drilled holes in another part. Consequently, when there is a series of holes, some allowance should be made to insure free assembly. In fact, the use of proper manufacturing tolerances and the selection of the right kind of stock has much to do with obtaining satisfactory results in producing die-made products. While only a few examples have been cited in this article, they represent important points and principles that may be applied to many other classes of work.

* * *

IMPROVED DIE-CASTING ALLOY

The accompanying illustration shows a die-cast test piece made by the Superior Die Casting Co., 874 E. 72nd St., Cleveland, Ohio, from an improved zinc alloy used by the company. The alloy is similar to the regular zinc alloy used for die-castings, but has been improved in a manner that increases both the tensile strength and the twisting resistance. As shown by the illustration, the test piece has been twisted to an angle of 240 degrees without showing the slightest signs of any cracks. Tests made on three test pieces showed a tensile strength varying from 47,530 to 50,170 pounds per square inch, and an elongation of from 3.5 to 6.5 per cent. The test bar is of the regular 1/2 by 1/8 inch section. It is possible to obtain these physical properties in regular everyday output of die-castings by maintaining the proper care in production.



Zinc-alloy Test Piece Twisted 240 Degrees without Cracking

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THE LEIPZIG SPRING FAIR

The Leipzig Spring Fair this year had much of interest to the visitor engaged in the machinery field. In the machine tool division, equipment for quantity production was especially in evidence, according to Acting Commercial Attaché Douglas F. Miller, of Berlin. Many copies of American designs were again noticeable, especially in the more highly developed types of machines. There were 150,000 visitors, including 20,000 from abroad.

MACHINE THAT TESTS 30,000 RADIO TUBES A DAY

A machine that tests radio tubes many times more rapidly than the most expert human operator has been installed at the radio tube factory of the Westinghouse Lamp Co. at Bloomfield, N. J. The capacity of this machine is 30,000 tubes a day, whereas the best human operator cannot test more than about 2000 tubes in a ten-hour day. Furthermore, the human operator is bound to make occasional slips in her work, but the machine never makes mistakes.

It consists essentially of a revolving disk, about 3 feet in diameter, which carries sockets for tubes on one of its faces. As the disk revolves, the tubes are connected successively to connections which test them for the various characteristics; and if a tube is found defective, it is thrown out of its socket by an electromagnetically acting plunger located at the rear of the machine. Tubes that are entirely bad are ejected into a scrap heap, but those that can be reclaimed are gently laid on moving belts which convey them to operators for further treatment. Perfect tubes are also placed on a belt and are carried to the wrapping department.

Testing Radio Tubes at the Rate of 30,000 a Day

The points for which tubes are tested are: Short circuits, broken filaments, emission, gassiness, and high and low plate current. Some of these tests involve the use of extremely small currents, and special sensitive relays are employed to operate the ejecting mechanism. Each test is a positive one, and each testing mechanism ejects tubes in case they become damaged during the process of testing. Hence, when the machine passes a tube, that tube is a good one.

The machine is arranged to be fed by two girls seated side by side. After it was placed in operation, the fact developed that one of the girls should be left-handed and one right-handed; but the machine is now being arranged to be fed automatically so as to bring it up to its full productive capacity.

* * *

The total capacity of water wheels and turbines in water power plants in the United States at the beginning of this year was 11,721,000 horsepower, an increase of 544,000 horsepower during 1926. Of the power capacity mentioned, 7,800,000 horsepower has been developed since 1910.

Machining Sleeve-Valve Cylinder Heads

THIRTY-SIX distinct turning, facing, boring, reaming, and threading cuts are taken during three operations performed in finishing cylinder heads for automobile engines manufactured by the Yellow Sleeve-Valve Engine Works, Inc., East Moline, Ill. These cylinder heads are iron castings of the design illustrated in Fig. 1. Important dimensions are held to tolerances varying from 0.003 to 0.006 inch. The operations are performed in Potter & Johnston automatic chucking and turning machines, the total floor-to-floor time for the three operations averaging 13.35 minutes per cylinder head.

The machine employed in the first operation is equipped with a universal three-jaw chuck, the jaws of which extend the full depth of the core between the outer and inner walls. The jaws clamp on the outer wall and assure concentricity of the various surfaces. Flange surface *l* seats against the face of the jaws.

The first step in this operation consists of rough-turning the outer wall to approximately the dimensions of surface *a*, and of core-drilling spark-plug hole *b*. These cuts are taken by tools *A* and *B*, Fig. 2, respectively, which are mounted on one face of the turret. While these cuts are in progress, the front cross-slide feeds toward the center of the machine, and tools face bottom *c*, Fig. 1, of the flange, and end *d*, while junk-ring groove *e*, is being turned. In this and all subsequent steps in which several cuts are taken by tools mounted on a turret face, a guide such as shown at *C*, Fig. 2, enters a rest to steady the tools.

After the turret has been indexed, upon the completion of the foregoing step, it is advanced for rough-machining combustion chamber *n*, Fig. 1; this operation is performed by a tool shaped to coincide with the outline of the chamber. Simultaneously, the rear cross-slide advances for facing shoulder *i*. The third and final step of the operation consists of boring spark plug hole *b* with a tool mounted on the third face of the turret, this being the step shown in progress in Fig. 2. The floor-to-floor time per cylinder head averages 4.85 minutes for the entire operation.

The jaws of the chuck used for the second operation grip the cylinder head on the large-diameter wall and hold the head with the flange and spark-plug tube extended toward the turret, as may be seen in Fig. 3. Tools on the first turret face rough-turn the spark-plug tube surface *g*, Fig. 1; rough-bore locating seat *h*; core-drill hole *j* of the spark-plug tube; and face end *k* of the tube. At the same time, tools on the front slide are employed to rough-face surface *l* of the flange and semi-finish-face surface *c*. This step of the operation was in progress when the photograph reproduced in Fig. 3 was taken.

After the turret has been indexed to bring the second face toward the work, it is advanced for finish-turning surface *g*, Fig. 1, of the spark-plug tube; finish-boring locating seat *h;* finish-reaming hole *j;* and finish-facing and rounding end *k*. At the same time, the rear cross-slide advances to carry three tools to the work. Two of these tools semi-finish-face bottom *c* of the flange and finish-face top *l*. The third tool finish-turns dowel surface *m*. The final step of the second operation consists of cutting the threads *t* of the spark-plug tube by means of a die-head mounted on the third face of the turret. In this operation, the floor-to-floor time averages 4.10 minutes per cylinder head.

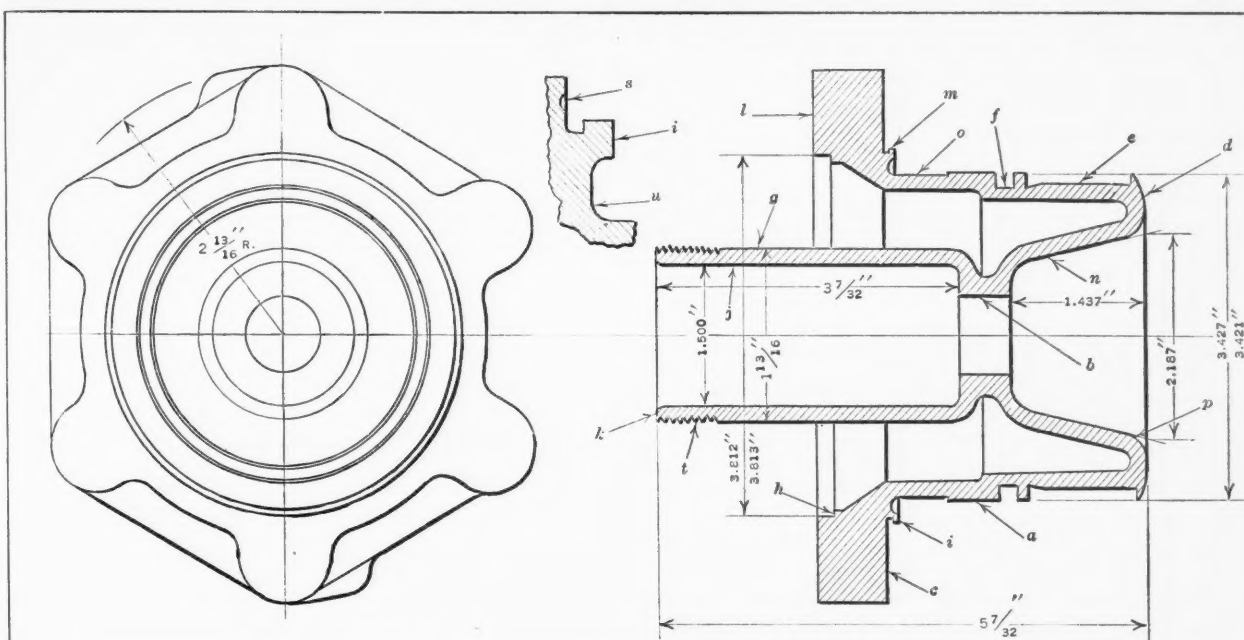


Fig. 1. Design of the Cylinder Head Used on Yellow Sleeve-Valve Automobile Engines

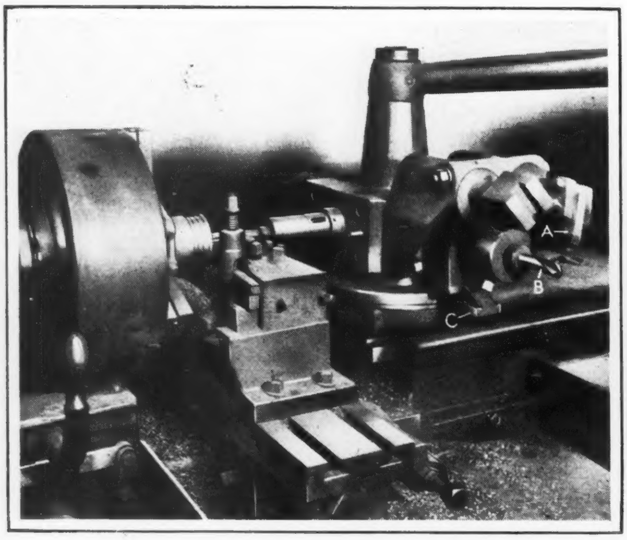


Fig. 2. Tooling Employed in the First Operation on the Cylinder Heads

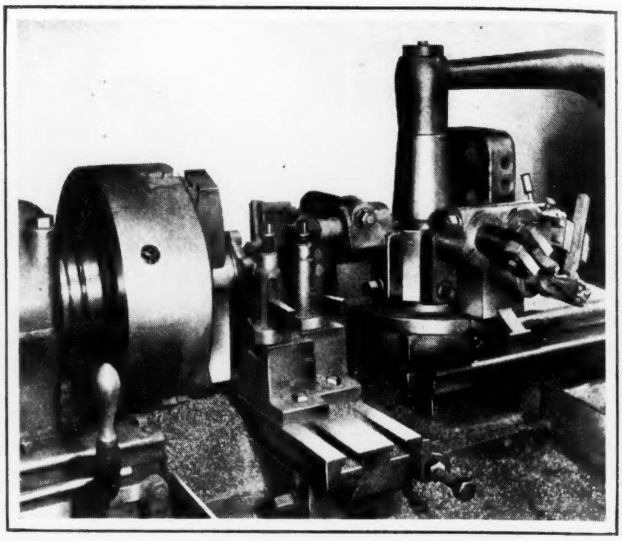


Fig. 3. Second Operation Performed on the Cylinder Heads

A special air-operated fixture is employed to hold the cylinder head in the third operation, as may be seen in Fig. 4. Threads *t*, Fig. 1, of the spark-plug tube are screwed into a socket to hold the part in place for the operation, and the bored seat *h* is employed in conjunction with a member of the chuck to locate the cylinder head endwise and insure true running. In the first step of the operation, tools on one face of the turret are employed to semi-finish combustion chamber *n* with a form tool; semi-finish-turn all surfaces of the same diameter as surface *a;* and cut gasket groove *s*.

The turret is then indexed, and tools on the second face finish-form combustion chamber *n* and turn the sleeve clearance groove *u*. The clearance groove is under-cut slightly, which necessitates the tool being held in a hinged block *A*, Fig. 4. While the tools of the second turret face are in operation, the front cross-slide feeds toward the work to advance tools for finish-turning junk-ring groove *e*, Fig. 1, as regards diameter; rough-turning ring groove *f;* and finish-turning relief *o*. At the same time, the rear cross-slide advances tools for finish-facing bottom *c* of the flange; turning a relief groove in back of dowel surface *m;* and finish-turning ring groove *f* and junk-ring groove *e* as regards width.

Finally, after being indexed, the turret advances a third time for finish-turning surfaces having the same diameter as surface *a* and finish-turning the rounded surface *p* adjacent to end *d*. The gages seen in Fig. 4 give an indication of the number of inspections required on each cylinder head before it leaves the machine. The average floor-to-floor time of the operation is 4.40 minutes.

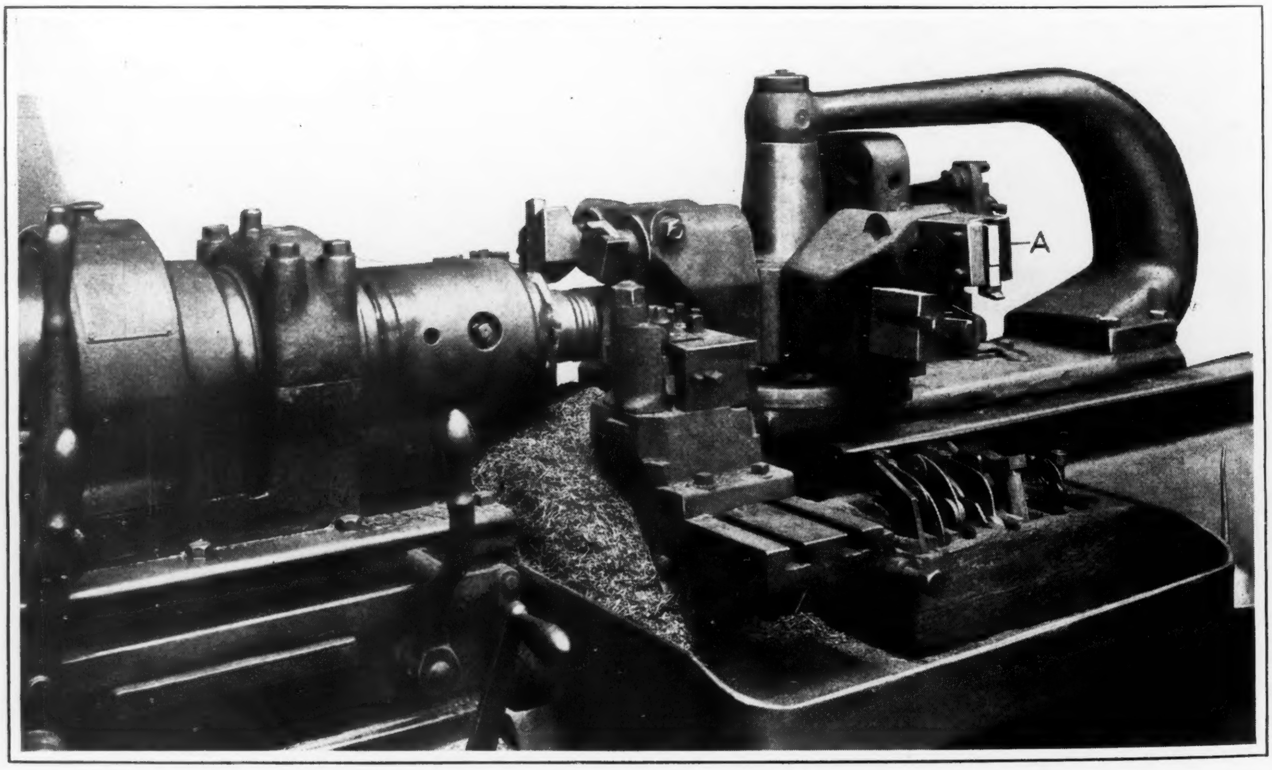


Fig. 4. Arrangement of the Tooling Employed for the Third Operation Performed in Automatic Chucking and Turning Machines

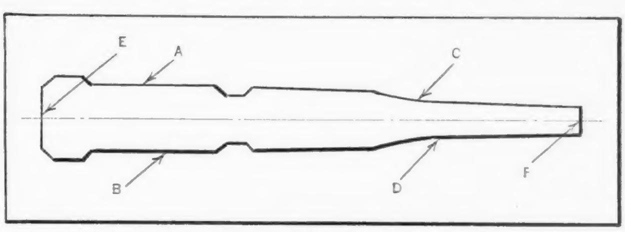
Paper Tests for Blanking Dies

By HENRY SIMON

IN an effort to provide a quick and positive way of examining the condition of certain blanking dies, the writer applied a method of testing by means of paper impressions, as described in this article. The dies upon which the test was first tried were of split construction, thereby permitting the clearance to be changed on all but minor surfaces.

The blanks were made from 0.080-inch crucible sheet steel, of about 0.75 per cent carbon content, and as the edges were required to show an exceptionally good finish, accurately maintained clearance between punch and die was of prime importance. Although the tools were mounted in heavy sub-presses and provided with positive relocating means, they were still subject to the effect of continued wear and other influences tending to disturb their alignment.

Grindings were relatively frequent, on account of the hardness of the material worked upon, and because of this and the severity of the service, a close check upon the condition of the cutting edges was necessary. The paper test provided a ready means for obtaining this information at frequent intervals, and was easily applied, as will be understood from the following description.



Outline of Die Opening on which Paper Test was Made

Method of Testing Die

The test consisted in placing a sheet of tough paper on the die and allowing the punch to enter to a depth of about 0.015 inch. In the case of the dies referred to, the clearance on a side was supposed to be about 0.0025 inch, and a bond paper of about 0.003 inch thickness was regularly used for the impression. Under such conditions, when the clearance is exactly right, it will be indicated by the clean folding of the paper all around without any breaks except, possibly, at very sharp angular corners. In other words, the paper is compressed about half a thousandth inch, and this is the case whether the edges of the tools are sharp or dull.

As soon as the clearance is decreased beyond this point, however, the paper will be broken; a very clean cut would show the existence of sharp edges on both punch and die, while a ragged cut would indicate either a dull punch or a dull die, in addition to insufficient clearance, or a condition where, although the tools are sharp, there is still enough clearance to prevent the paper from being cleanly severed and yet not enough to keep it from being broken. Examination with a high-power glass will show which cause exists, as the dullness or sharpness of any portion of either punch or die will be reflected in the appearance of the impression of the cutting edge in the paper.

It was found that it did not require much experience to read correctly the indications of the paper impressions. When there was any doubt as to the existence of sufficient clearance, however, this was solved by repeating the test on a piece of paper about 0.002 inch thick. If this paper was broken, the evidence was conclusive that there was insufficient clearance at that point.

It was seldom found necessary to use additional tests to ascertain if there was too much clearance, but sometimes such a test was made by using paper about 0.005 inch thick. If this was not cut, it was plain that there was excessive clearance at that point. The paper method, therefore, formed a practical way of limit-gaging the clearance between the tools while they were set up and in use on the press, besides showing the state of the cutting edges. The same general information could, of course, be obtained from the work itself, but the paper impression gives this information in a much more definite way, and reduces it to a measurable quantity.

Practical Application of Paper Test

With what degree of assurance the dies in question were re-adjusted, solely on the basis of the information obtained by the paper test, will be seen from the following example: As the tools wore down, it became necessary to take up excess clearance in the die by grinding one or both of the meeting faces of the die halves, and to change the shims which were placed behind the die-block. Sometimes it was also necessary to turn the punch slightly. The extent of such changes, which had formerly been difficult to estimate, was instantly made clear in every essential detail by the paper test. The impression of a die having an opening of the shape shown by the outline in the accompany illustration was taken just after a regrind, with the edges of the tool sharp. The lower left edge near *A* showed the paper cleanly cut, while the opposite edge at *B* was sharply folded and partly broken, but along the upper surfaces at *C* and *D*, the paper was lightly folded, with no part broken.

This plainly showed the opening to be too wide toward the small end, while it was about right near the lower end. Instructions were therefore given to taper the meeting surfaces of both die halves from *E* to *F*, taking about 0.001 inch off each block at the opening and reducing it by about 0.002 inch. The back edge of the die-block was then ground parallel with the inner edge, this operation reducing the previous width of the block by a total of about 0.002 inch. As the test showed the punch to be centered, it was only necessary to use

a shim 0.002 inch thicker than the original one in order to realign the punch and die properly.

Another paper test, taken after these operations had been carried out, showed the shape cleanly cut along one side, with most of the remainder partly folded and partly broken, the indications being that of a condition of minimum clearance all the way around. During work this would be somewhat increased laterally through a slight spreading of the die under the cut.

Because of the ease and rapidity with which the test can be made, it was found that it paid to make a paper impression after every grinding of the punch or the die, or whenever slight defects appeared in the product, and it was made a rule not to allow the press to proceed until the impression had been marked O.K. By using standard loose-leaf sheets and filing them away, a graphic record was made, from which the condition of a die could be judged, and the necessary corrections made.

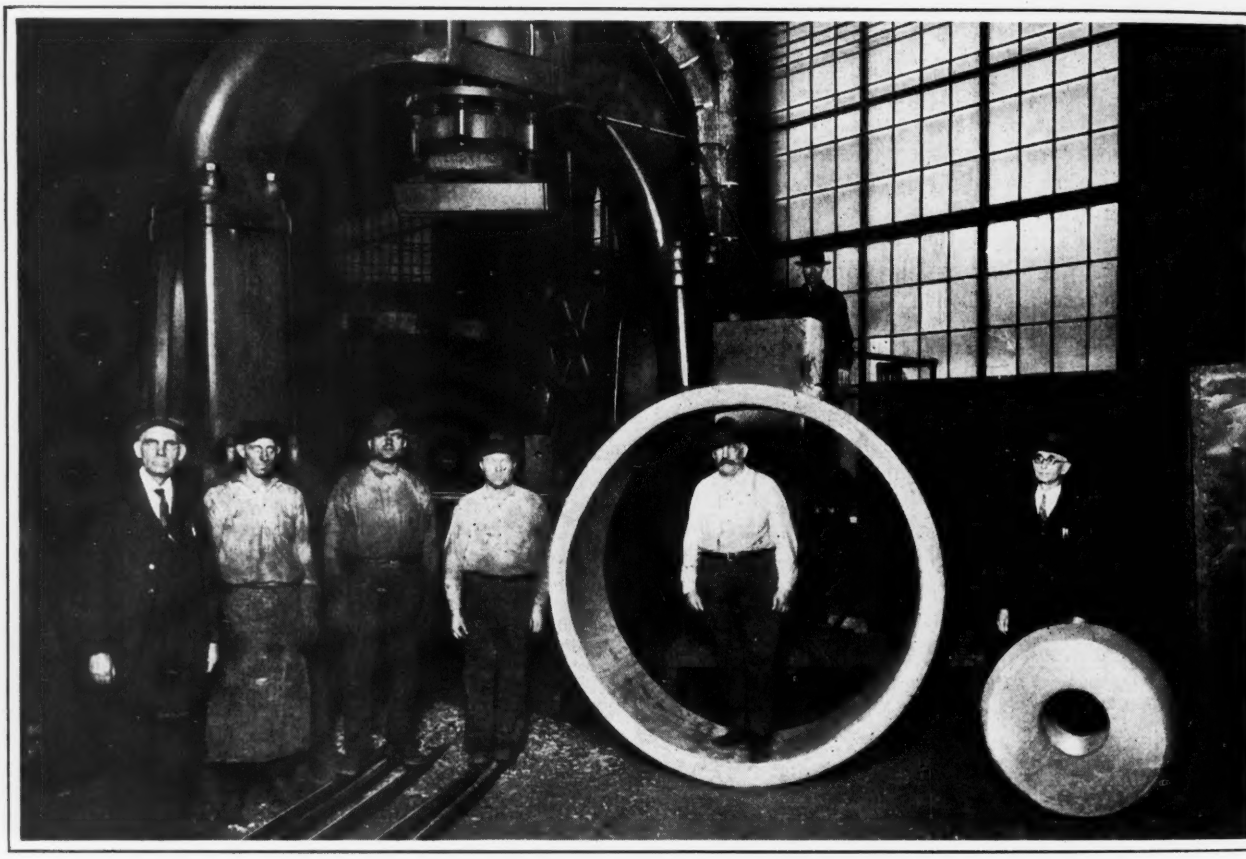
The method showed up equally well when applied to dies not of the sub-press type, but mounted in plain punch-holders and die-shoes. Among the innumerable dies of this type, there should be many instances where it could be used to advantage in setting the punch and die as well as in checking up during the course of the work.

* * *

Continued progress is being made in the use of steam turbines for ship propulsion, and the internal combustion engine is steadily increasing in favor. In 1926 no less than thirty-seven ships totalling 201,900 tons were launched in British and Irish yards fitted with internal combustion engines. This was equal to nearly 47 per cent of the steam tonnage launched.

FORGING A FOUR AND A HALF TON RING

The accompanying illustration shows the largest retaining ring which has ever been forged in the Schenectady plant of the General Electric Co. The ring weighs 4 1/2 tons, and is to be used in a 60,000-kilowatt turbine-generator now under construction at the Schenectady plant. The ring was forged from a solid billet of nickel steel, 32 inches in diameter and 42 inches long. A small hole was pierced by a 6-ton forging hammer to 11 inches in diameter, and by successive heating and forging under a 3-ton hammer, the ring was enlarged to the size shown. The outside diameter of the completed ring is 79 inches, and the inside diameter is 69 inches. The face measures 27 inches across.

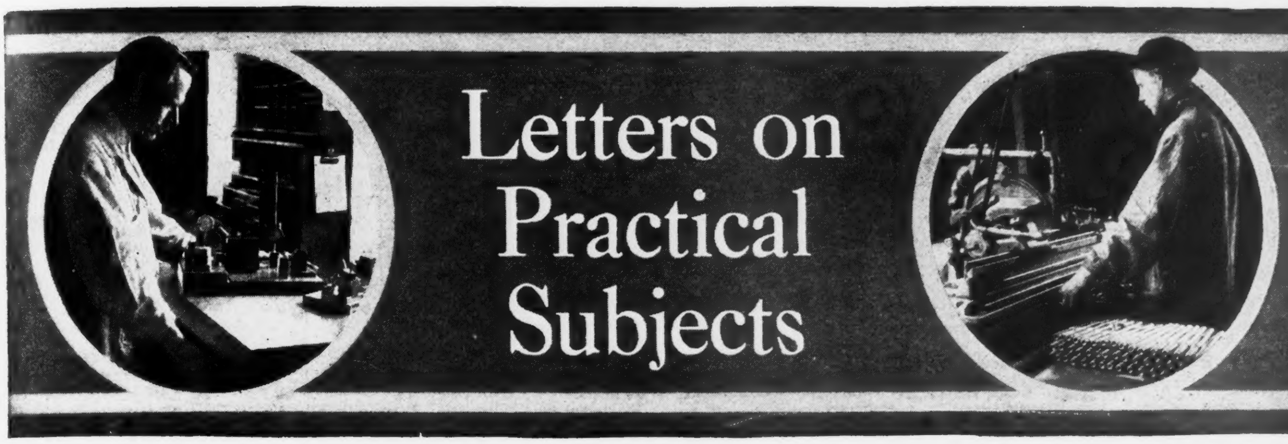


Large Ring and Billet from which it was Forged

* * *

MEETING OF INDUSTRIAL ENGINEERS

The fourteenth national convention of the Society of Industrial Engineers will be held in Chicago at the Hotel Stevens on May 25 to 27. The subject of the meeting will be "The Principles of Effective Management and their Relation to Industrial Engineering." The sessions will be held in the mornings and evenings, the afternoons being devoted to inspection of plants in the Chicago district. A feature of the convention will be an exhibition of charts, photographs, production control boards and allied devices, psychological test appliances and materials, and a special display showing what has been accomplished by some industries in the simplification of their line of products. Further information can be obtained from the headquarters of the society at 608 S. Dearborn St., Chicago, Ill.



AIR-PUMP VALVE-GRINDING MACHINE

A pneumatically operated machine is used in the Huntington Shops of the Chesapeake and Ohio Railway Co. for grinding air-pump valves and their cages, and this machine has proved very efficient. Two valves are ground at the same time, and each one is given a reversing motion while grinding, in order to obtain a tight joint and prevent scoring.

A commercial air motor (No. 3S "Little Giant") drives the machine. This motor, shown at *A* in the accompanying illustration, revolves an eccentric *B*, which has a throw of 5/8 inch. The eccentric, through a rod connection, imparts an oscillating movement to segment gear *C* which is in mesh with pinions *D*. The valves to be ground are attached to the spindles carrying pinions *D*, and are thus given a reversing motion. One valve is held at *E* and another at *F*.

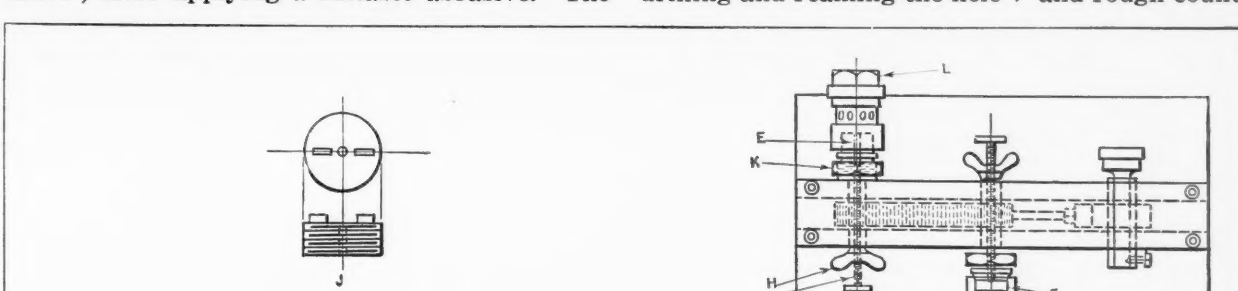
First the valve is screwed on a threaded rod *G*, and then thumb-screw *H* is tightened, thus drawing valve *E* up against plug *J* (see detailed view) which is located within nut *K*. After nut *K* is screwed up against the valve, the latter is ready for grinding. This is done by starting the motor and holding cages *L* against the valves at positions *E* and *F*, after applying a suitable abrasive. The column *M* is made of a piece of 3-inch standard pipe, and it is welded to a base 12 inches in diameter. This machine was designed by G. M. Points, gang foreman.

Huntington, W. Va. E. A. Murray

TOOLS FOR MACHINING A HARD RUBBER HALF-SPHERE

The tools used in machining the hard rubber half-sphere shown at *W*, Fig. 1, are described in this article. The work is a true half-sphere with a shoulder, indicated by dimension *Z*, cut back from the center, and with a hole *V* through the center, which is reamed and counterbored at *S*. Two of the half-spheres are assembled with a disk *T* between them, and the complete unit is assembled in a water meter.

The parts are rough-molded by an outside concern, which specializes in hard rubber products. In finishing the work, about 1/16 inch of material is removed from all the surfaces, and the dimensions must be held to extremely close limits. Gages are used for testing the work throughout the machining operations. The first operation consists of drilling and reaming the hole *V* and rough-counter-



Machine for Grinding Two Air-pump Valves at the Same Time, a Standard Air Motor being Used for Driving

boring the hole *S*. This is done in a small hand turret lathe, the half sphere being gripped on its shoulder in a three-jaw chuck. Standard tools are used.

The second operation consists of finishing the shoulder, and is performed on a bench lathe equipped with a six-face turret on which the special tools shown in Fig. 1 are mounted. The arbor *F* is gripped in the spring chuck *B* of the lathe. The work is driven over the arbor by the loading and stripping tool *C*, held in the turret. The strap *D* on this tool is swung back, and the front end of the shank *E* is used to force the work over the arbor. The pilot of arbor *F* is a force fit in the reamed hole in the work, and has a triangular shaped portion *G*, with sharp edges, as indicated at *H*. The sharp edges cut into the rough counterbored hole, as indicated at *G*, and thus hold the work in place during the machining operation. Before the triangular arbors were developed, an ordinary expanding mandrel was used, the blades of which were forced against the walls of the reamed hole of the work by a draw-back rod. It was found, however, that chatter occurred with this type of holder, and that the extreme accuracy required could not be consistently obtained.

As shown in Fig. 1, the cross-slide tool bits *J* and *K*, held in an ordinary tool-block, were brought in to rough- and finish-machine the face *I*. It may be of interest to note here an important difference between the finishing of hard rubber and metal. From experience it was found necessary to use diamonds in turning and forming the hard rubber. The regular high-speed steels, and even stellite, did not stand up under production conditions. Tool bits *J* and *K* are tipped at *L* with pieces of bortz. These tools were obtained from an outside firm.

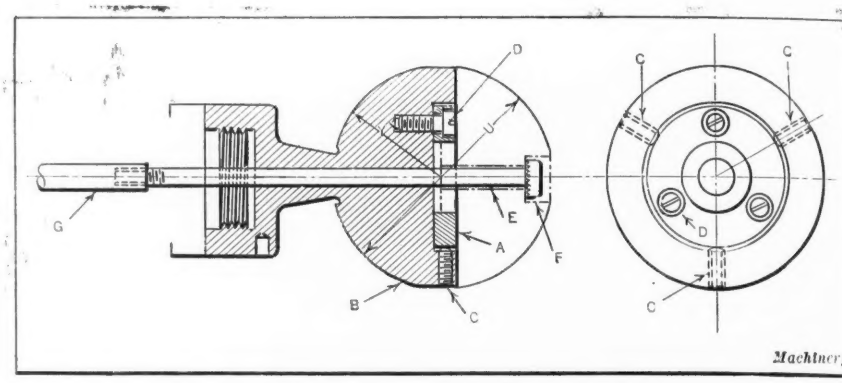


Fig. 2. Chuck Used in Machining the Half-sphere

After face *I* is finished, the shoulder *X* is cut by tool *M*. The tool bit *N*, which is diamond-tipped, is held in the adjustable block *P*, and the required accuracy of the cut insured by the pilot bar *Q*, which fits the bushing *R* in the headstock of the lathe. When these operations are completed, the work is stripped from the arbor by the strap *D* on the turret tool *C*. Strap *D* swings over and against the back side of the ball, as shown, so that when the operator withdraws the turret, the work is stripped.

The next operation must be performed with extreme accuracy, and consists of finishing the outside diameter of the half-sphere. This is done on another bench lathe, the work being chucked on its finished shoulder in the hardened and ground adjustable ring *A*, Fig. 2. The ring *A* is secured to the body of the chuck *B* with machine screws *D* and set-screws *C* as shown. The ring *A* is periodically adjusted to run true with the center of the lathe by means of the set-screw *C*, after which it is securely clamped in place by tightening screws *D*. The chuck body is threaded to fit the spindle nose of the lathe, and is turned to a radius *Y*, so that the diameter *U* can be readily measured.

The half-sphere is gripped throughout the operation by the rod *E*, which is slipped through the hole in the work so that the head *F*, which has teeth cut on its under side, is in contact with the bottom of the rough-counterbored hole. The teeth in the head *F* are thus forced into the rubber by the action of the lathe draw-bar *G* which is screwed on the end of rod *E*. An ordinary hand swivel tool, centered on the cross-slide of the bench lathe, is used to finish the outside or spherical surfaces of the work. Roughing and finishing cuts are, of course, required. The last operation consists of finishing the counterbore *S*, Fig. 1.

New York B. J. STERN

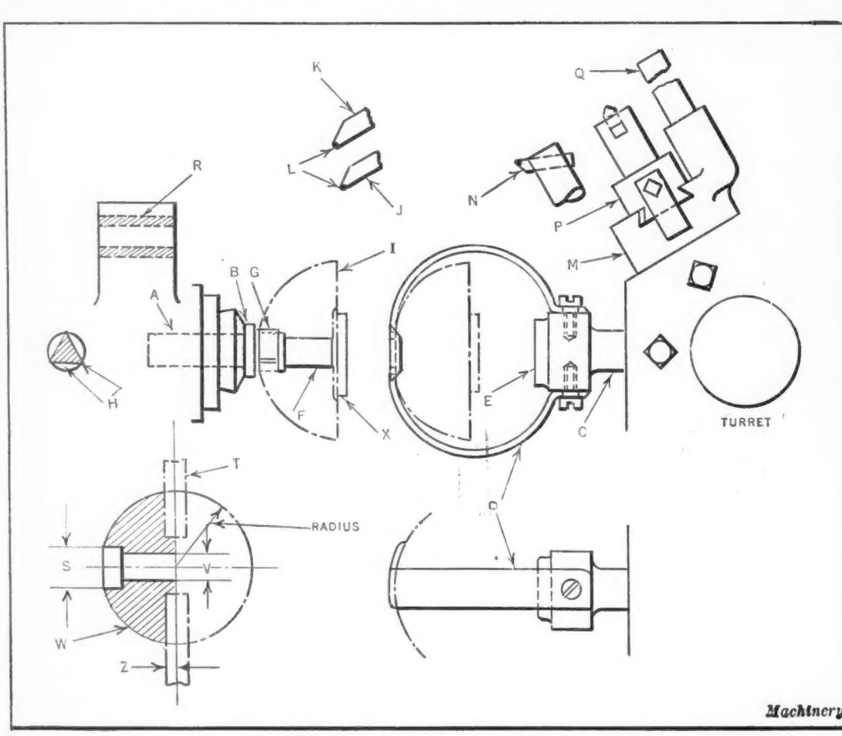
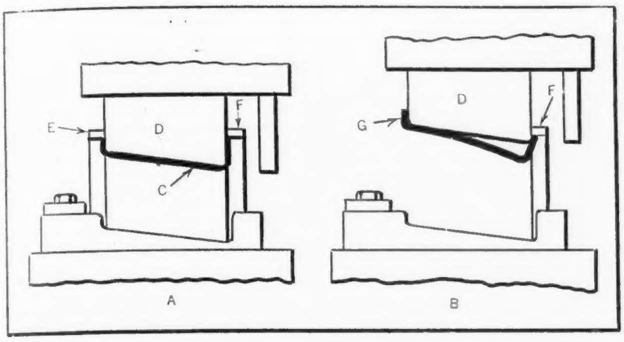


Fig. 1. Tools Used in Machining a Hard Rubber Half-sphere

A BREAKDOWN THAT INCREASED PRODUCTION

At *A* in the accompanying illustration, is shown a die for cutting off and forming round wire to the shape shown at *C* on the



(A) Die Equipped with Strippers E and F; (B) Die with Broken Stripper Removed

punch D. As a comparatively small number of pieces were required, it was not thought necessary to attach a knock-out plunger, so the two strippers E and F were attached for the purpose of stripping the stock from the punch. This required that each piece be pushed off the die before cutting the next, but this was considered satisfactory.

After operating for some time, the stripper E was broken off at the lower bend. As the work was required in a hurry, it was decided to try the die with only the stripper F. The results were surprising. The view at B shows the action that took place. The short foot G of the work remained in position on the punch, while the stripper F caused the work to spring around the corner of the punch D, as shown. As soon as the end of the long foot of the work cleared the corner of the punch, the tension caused by the spring of the work was released, and the work sprang back into position, throwing it clear of the die. This permitted the stock to be fed through the die continuously, and proved such a time-saver that several other dies in the shop were altered in the same manner.

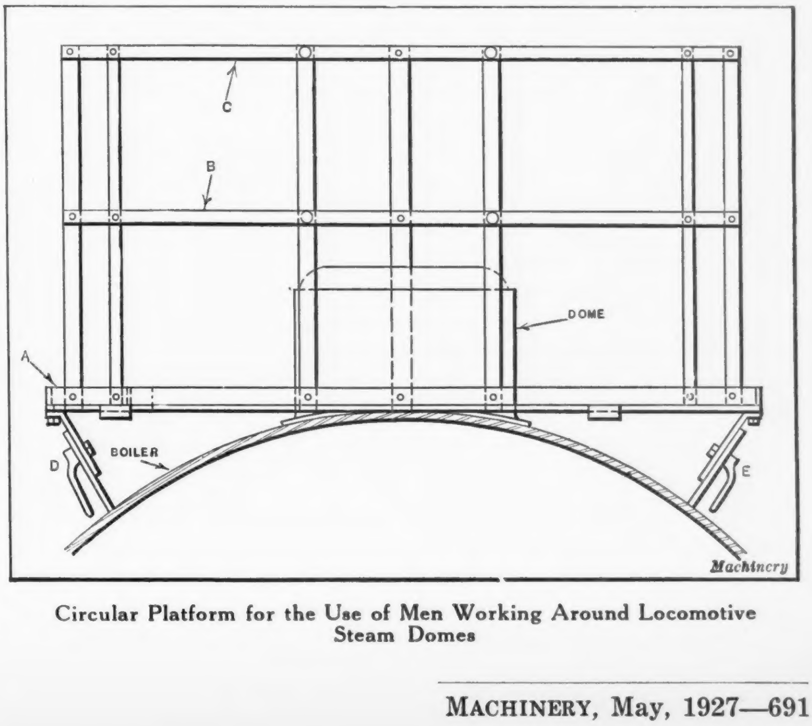
Philadelphia, Pa. R. H. KASPER

WORKING PLATFORMS FOR STEAM DOMES

A safety platform for the convenience and protection of men working in or around locomotive steam domes is used in the San Bernardino Shops of the Atchison, Topeka & Santa Fe Railway. If workmen are obliged to stand on the boiler, there is always chance of their slipping or falling, and a level platform with guard rail not only safeguards them, but saves time as well.

This platform (see illustration) is circular, and is 6 feet in diameter. A 24-inch opening at the center provides clearance for the steam dome. Two-inch angle-iron is used for the bottom ring A, and this is provided with floor braces and a wooden flooring. The guard rail is about 34 inches high, and is formed of 3/8- by 1 3/4-inch iron for the uprights and 1/4- by 1-inch iron for the circular bands B and C. At D and E there are adjustable braces which bear against the boiler and prevent the platform from tilting. The two sections of these braces have elongated holes so that they can be lengthened or shortened to suit the boiler. Hand-lever nuts are used to hold the sections after adjustment. This platform was designed by F. B. Harmon, assistant superintendent of shops.

San Bernardino, Cal. J. R. PHELPS



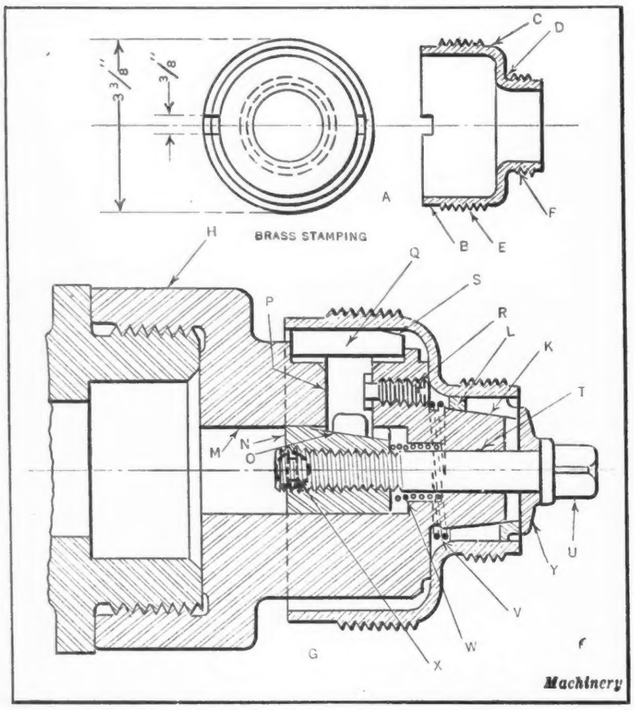
Circular Platform for the Use of Men Working Around Locomotive Steam Domes

EXPANDING ARBOR FOR THIN BRASS STAMPING

When forming or threading operations are to be performed on thin brass stampings, it is necessary to hold them in such a way that they will not spring away from the tools and cause chatter. In the example shown at A in the illustration, the work is 3 3/8 inches in diameter and of thin section. The outside is formed at B, C, and D, and threads are cut at E and F, in addition to the other obvious operations. To hold the work firmly and prevent it from springing under the pressure of the forming cuts, the arbor shown in the section view at G was designed.

The nose-piece H is of steel, pack-hardened and ground where necessary, and screwed to the end of the spindle as indicated. The forward end is tapered at K to take the split bushing L. The latter is split in six places, three from each end, 120 degrees apart, those at one end being midway between those at the other and extending to within a short distance of the end. This is done to allow the bushing to expand equally throughout its length. In the center of the nose-piece is a ground hole M in which the cam N is a sliding fit. This cam is slotted in three places, 120 degrees apart, on an angle of 15 degrees, as shown at O. There are three holes in the body of the nose-piece at P at distances corresponding with the slots in the cam, and in each of these holes there is a pin having a large head on it, as shown at Q.

The outside of the pins is ground to fit the inside diameter of the work, and the heads are large enough so that when all three pins are in contact, they touch approximately one-half of the interior surface. With so large a contact, the tendency to distort the work is very much lessened. There are three screws R in the end of the nose-piece, and these serve to limit the movement of the pins in



Expanding Arbor for Thin Brass Stamping

either direction. The front end of each pin is beveled at S to facilitate placing the work on the arbor. Through the center hole T, there is a special collar-head cap-screw U, which is threaded in the cam, thus giving the required movement. A coil spring at V and another at W assist in releasing the expanding members. The work is driven by pins on either side of the nose-piece, as shown at X. These pins enter slots that are cut across the large end of the work.

The operation of the device is of a compensating nature, as the cap-screw is threaded in the cam, so that when it is revolved in a right-hand direction, it tends to move forward, thus forcing the pins P outward until they strike the inside of the work. At the same time the washer Y moves the bushing L backward on the taper K until it also fits the inside of the work snugly. As there is a floating action in the mechanism, any slight variations in the interior diameter are compensated for, and the work is held firmly on the arbor.

Detroit, Mich. ALBERT A. DOWD

WORKING DIMENSIONS ON DRAWINGS

One of the difficult tasks with which draftsmen are confronted is the dimensioning of detail drawings to the satisfaction of workmen in various departments of the shop. Drawings of castings are the most difficult to dimension, as they are often used in the pattern shop, the machine shop, and in some instances in the tool-room. In each of these departments only certain dimensions are required, and naturally, each workman feels that the dimensions he requires are of the greatest importance and should be given a prominent place on the drawings.

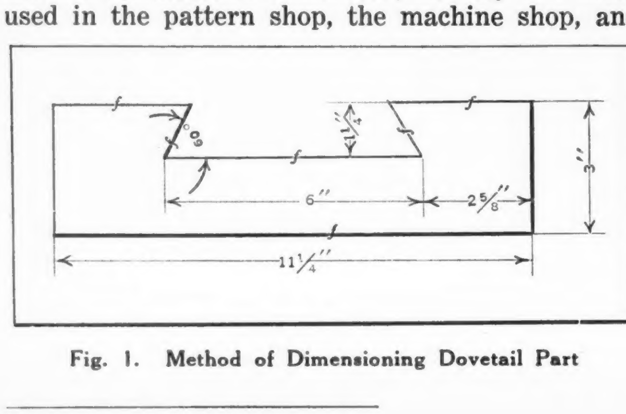


Fig. 1. Method of Dimensioning Dovetail Part

The patternmaker's requirements are more easily met than those of the other workmen, as he is not expected to make close fits, and in cases where a fit is required on the finished work, he merely adds the finish allowances. A sufficient number of dimensions is generally all that is required by the patternmaker.

For the machinist, the figures must show which surfaces and holes are related, and the degree of accuracy required. By placing notes where needed, no undue trouble should be encountered in the case of ordinary parts. It is with such work as fitting dovetail joints that the machinists often question the methods used in dimensioning the work.

In Fig. 1 is shown a dovetail part, as often dimensioned when using only fractional dimensions. It is entirely possible to machine this part to the dimensions specified, allowing tolerances, such as plus or minus 0.010 inch for fractional dimensions, but the machinist is not satisfied with the dimen-

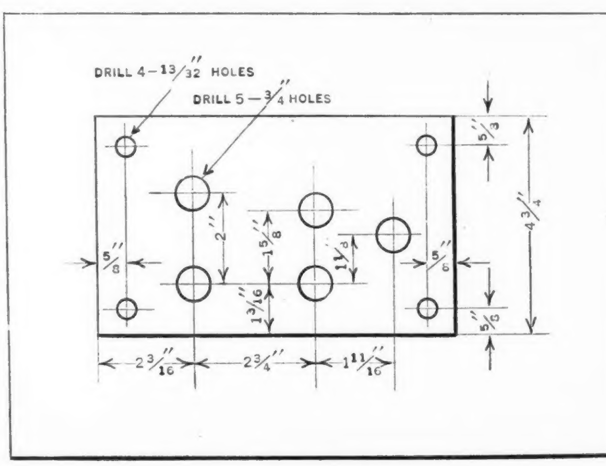


Fig. 2. Lay-out for Drilling Holes in Jig

sions given. He feels that it is difficult to measure the distance between the sharp corners indicated as 6 inches and that a dimension should be given for the top of the dovetail, which could be more easily measured. This naturally gives the impression that the draftsman does not know how to dimension drawings, whereas, the omission of the dimension at the top was intentional.

The calculated dimension for the top of the dovetail is 4.556 inches, which is an odd decimal. If this dimension were put on the drawing, the fractional dimension tolerances would no longer apply, as the decimal numbers would be closely followed. Also, it would be impossible to finish a casting with accurate and sharp edges between which accurate measurements could be made. The two-roll method should be used for very close work, but for ordinary parts, the method of dimensioning shown in Fig. 1 is satisfactory, as in most cases gibs are provided that can be fitted to compensate for any variation in the width of the dovetail slot.

The toolmaker's problems are, in general, similar to those of the machinist. In Fig. 2 is shown a typical lay-out for drilling holes in a jig. The

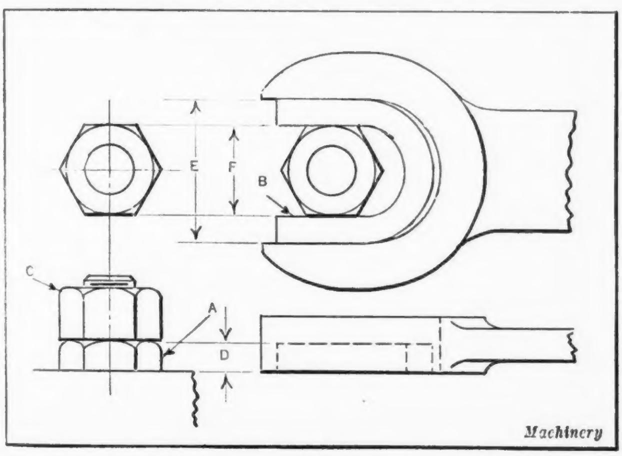
toolmaker needs dimensions on the diagonal lines between all the holes in order to permit him to measure across buttons when boring a jig. All these dimensions would be odd decimals, and if placed on the drawing, would indicate extreme accuracy in the finished work. The draftsman must show what is wanted in the completed part. Toolroom problems of the type shown should be handled by the jig designer. He can furnish the desired figures on the jig drawing, and this will not affect the work in production departments.

The following points should always be borne in mind: First, the detail drawings must show what is wanted, including the degree of accuracy required; second, machining or toolmaker's notes that call for unnecessary accuracy should be avoided; third, a drawing dimensioned in accordance with good engineering practice shows the piece properly and meets most shop requirements.

Worcester, Mass. LAWRENCE F. SWENSON

WRENCH FILLER FOR LOOSENING THIN NUTS

Difficulty in removing thin nuts like the one shown at *A* in the accompanying illustration may be eliminated by using a filler piece *B* in combina-



Method of Using Filler Piece to Loosen Thin Nut

tion with a wrench having an opening large enough to turn over the upper nut *C*. In removing motor or engine foundation bolts secured by a thin and thick nut as shown, it is often necessary to turn the thin nut *A* slightly, in order to prevent twisting off the bolt. The wrenches usually available, however, have jaws that are too thick to permit turning the lower nut without turning the upper one. No difficulty is experienced when filler pieces *B* with a thickness *D* slightly less than the height of the thin nut and of the proper dimensions *E* and *F* are used.

Washington, D. C. G. A. LUERS

REMOVING VALVE ECCENTRIC ARMS

The accompanying illustrations show a device for pulling off valve eccentric arms from locomotive crankpins. For the benefit of those not familiar with locomotive construction, it may be said that the valve eccentric arm is located on the end of the main driving rod pin, and transmits motion to the valve gear, which controls the intake and exhaust steam to and from the cylinder. The ec-

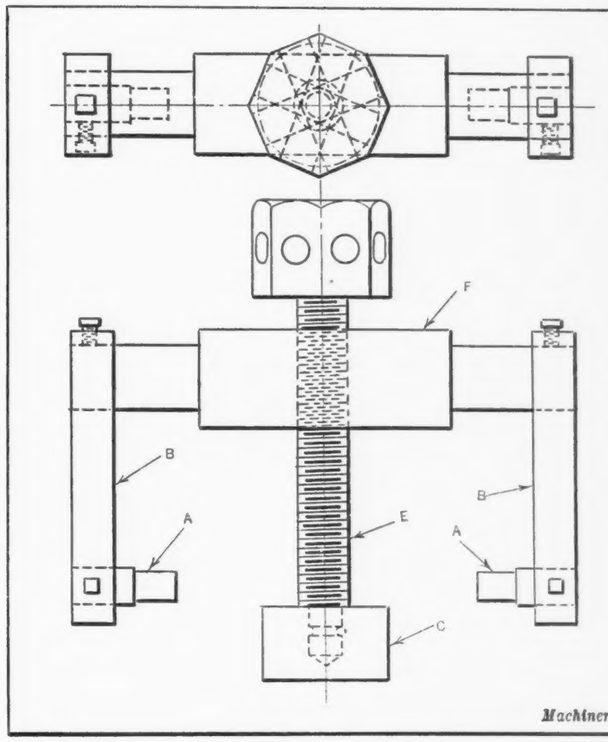


Fig. 1. Device for Removing Valve Eccentric Arms

centric arm derives its name from its eccentric motion, acting in opposition to the driving rods.

When a locomotive is shopped for repairs, the eccentric arm is invariably removed from the main pin for repairs to the pin, the wheel, or the arm itself. The common practice in removing the eccentric arm is to drive a wedge in the slot to loosen the arm on the crankpin, and then drive it off with a sledge hammer or force it off with a wedge inserted at the back of the arm.

A device constructed as shown can be easily applied to any class of engine by inserting the two movable pins *A*, Fig. 1, in the bolt holes of the eccentric arm *W*, Fig. 2, and adjusting the arms *B*, Fig. 1, so that the floating member *C* is located in the center of the crankpin. The member *C* is held in position and prevented from coming off by means of a small pin that fits in a groove in the end of the screw. The required pressure is applied by a small bar inserted in one of the holes in the head of the screw *E*, the bar being used as a lever

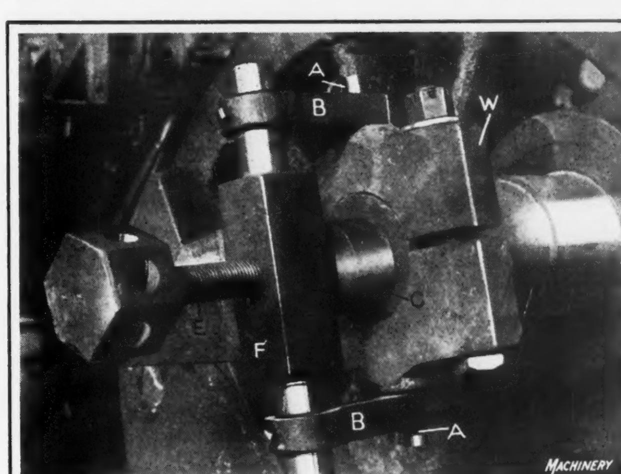


Fig. 2. Pulling Device in Position for Removing Valve Eccentric Arm

to turn the screw. By applying pressure in this manner, the arm can be easily and quickly removed without being damaged in any way. The arms *B* can be adjusted to fit any size eccentric arm, as they are movable on the arm *F*. None of the parts of the device are likely to be bent or broken, as the pulling power is applied directly to the eccentric arm.

Portsmouth, Ohio — F. H. WICKS

FORGING DIE FOR SELF-ALIGNING BEARING BRACKET

A great many forged pieces are required in constructing agricultural implements. Dies of various designs are employed in producing the forgings, which results in a great saving of time and cost over the hand-forging method. In Fig. 1 is shown a self-aligning bearing bracket used on a certain type of agricultural machine. This piece is forged from mild steel flat bars, 4 inches wide and 3/16 inch thick, with a finished length of 7 inches. A plan of the finished piece is shown in the upper view, and a side elevation in the lower view. The piece is sheared from the bar stock, and all holes, including a 1 3/8-inch diameter hole at *G*, are punched by the die shown in Fig. 2.

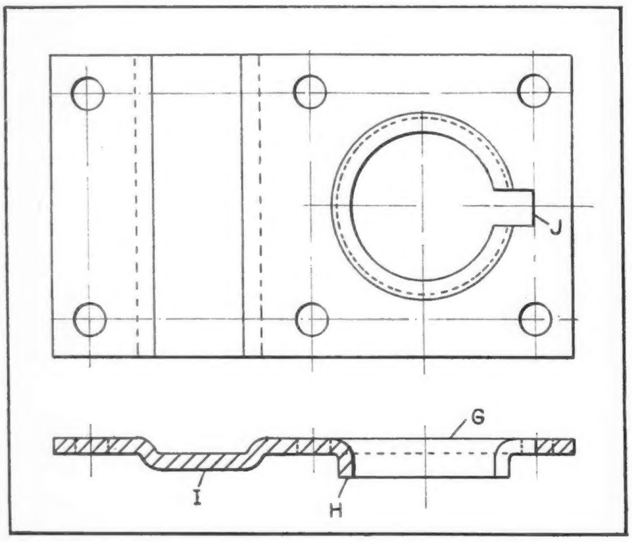


Fig. 1. Self-aligning Bearing Bracket

Referring to Fig. 2, the upper die member *A* holds the punches. The lower die-block *B* holds the four dies and the lower shear blade *C*. The lower shear has countersunk holes on both sides, so that the blade can be reversed. This permits four sharp edges to be used before regrinding is necessary. The shear blade is made to shear the stock before the punches strike the metal in order to prevent the punches from being broken. The punches *D*, *E*, and *F* must be located by experiment, in order to have the holes in their proper positions after the forging operations have been performed in a later operation. A gage is fastened to the stripper (not shown in the illustration).

Referring to Fig. 1, it will be noted that the swaged hole *G* is finished with a flange *H*. It will also be noted that hole *G* is provided with a recess *J* along one side. The object of the swaged hole and the recess is to provide an extended support for the bearing, not shown, and to prevent rotation of the bearing in the support. The depressed portion *I* in the piece is provided to receive a corresponding rib on the frame of the implement. Ordinarily, a set of drop dies would be used to produce the depression at *I*, and the swaged portion *H* of the hole *G*, including the recess *J*. A higher rate of production can be obtained, however, by employing a die like the one shown in Fig. 3.

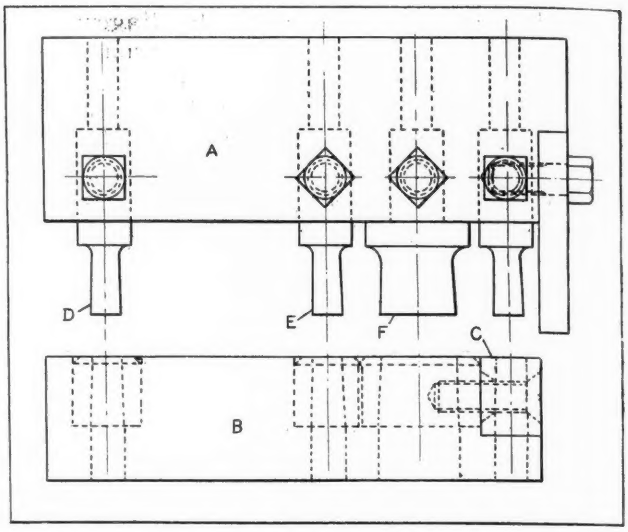


Fig. 2. Piercing and Cutting-off Die for Part Shown in Fig. 1

The upper die-block *K* of the forging die, Fig. 3, is equipped with a forming punch *L* and a die *M* for forming the depression *I*, Fig. 1. A spring-actuated stripper *N* is supplied to eject the work from the receding die. The spring stripper strikes the work and holds it while the piece is formed and swaged. The flange is formed by the punch *L* before the punch *P* strikes the work. This arrangement is necessary in order to produce a flange that will be flush all around the bottom edge. If the punch *P* should strike the work ahead of the forming punch *L*, the corners of the flange would spread apart while the flange was being formed, as the stock is heated all over in a fuel oil furnace to a cherry red.

Moline, Ill. — H. E. HERMANN

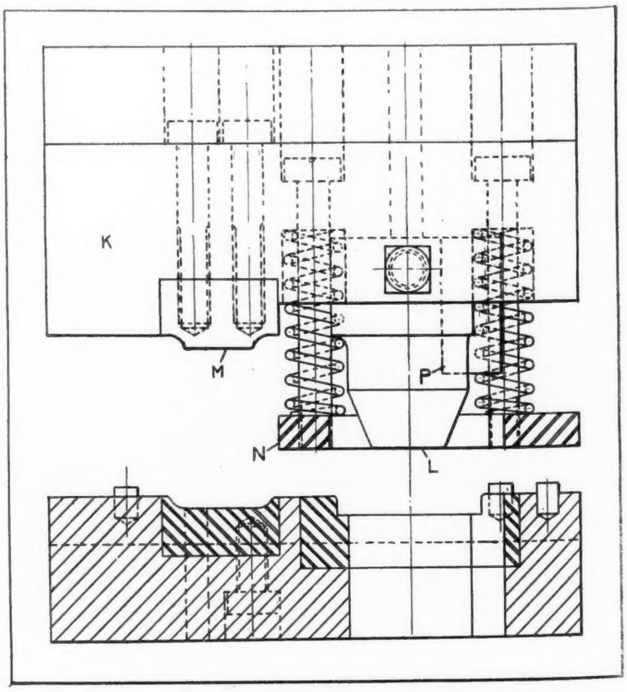


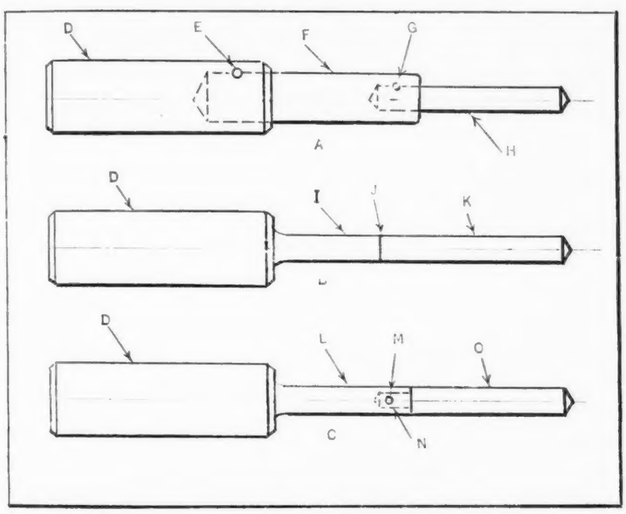
Fig. 3. Forging Die for Part Shown in Fig. 1

Shop and Drafting-room Kinks

EXTENSIONS FOR DRILLS, TAPS AND REAMERS

In the accompanying illustration are shown three types of extensions employed by one manufacturer for drills, reamers, and taps. The extension shown at *A* is used when it is possible to employ a diameter larger than that of the drill or reamer. The extension shown at *B* is used for small-diameter drills, taps, and reamers when the extension member is required to be the same diameter as the drill. At *C* is shown an extension used for larger drills, taps, and reamers when the diameter must be the same as that of the tool.

The three designs shown have been used quite extensively, and have all proved satisfactory. Referring to the design shown at *A*, *D* is the member



Extensions for Drills and Reamers

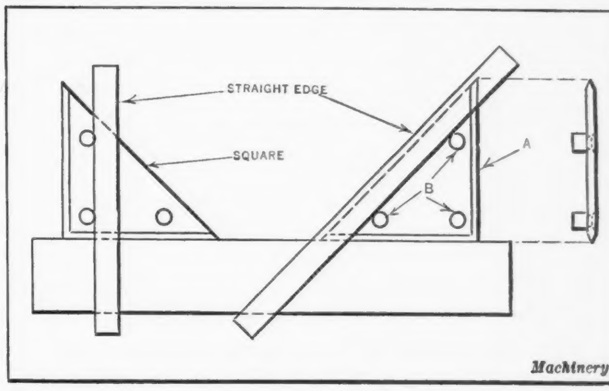
gripped in the collet or chuck, *F* the extension, *E* the pin used to hold the extension in place, *H* the drill, which, if smaller than 1/2 inch, is soldered to the extension, and *G* the pin used to secure drills larger than 1/2 inch in diameter.

In view *B*, the extension *I* and the part *D* are made from one solid piece, and the drill *K* is joined to the extension by a butt weld at *J*. The extension shown at *C* has the end *L* joined to the drill *O* by a pilot joint *N* held in place by a pin *M*.

EDWARD T. HEARD
Rochester, N. Y.

KNIFE-EDGE SQUARE WITH PINS FOR LOCATING STRAIGHTEDGE

The toolmaker's and machinist's square shown in the accompanying illustration will withstand considerable rough usage. It is made from a solid piece of tool steel *A*, with the edges ground to a bevel knife-edge. Three small studs *B* of hardened steel are accurately located and set in one



Special Square with Pins for Locating Straightedge

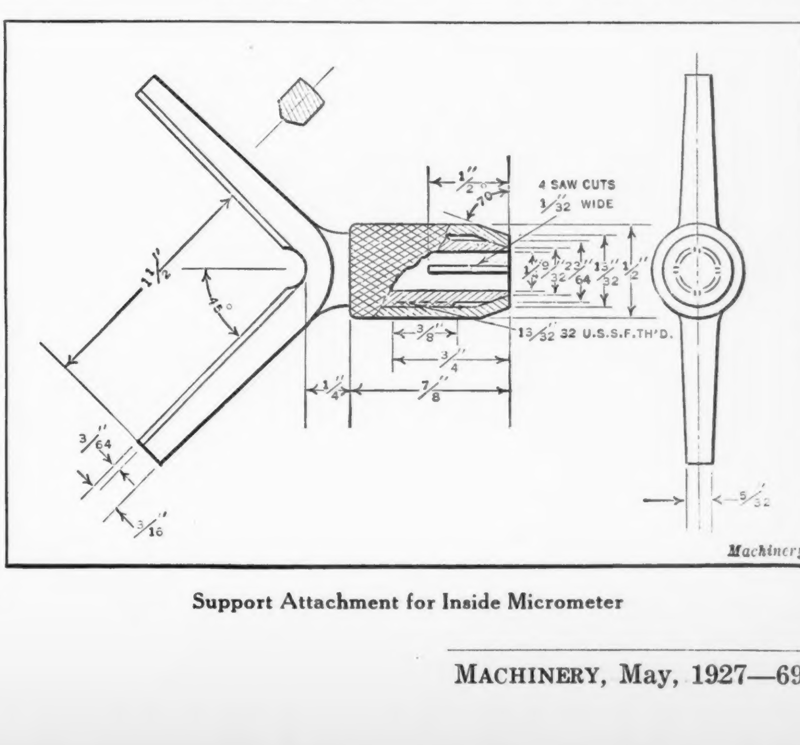
side of the square to form a right triangle having two legs of equal length. These can be used in much the same manner as the sides of the triangle. Small "feeler" or thickness gages can be conveniently employed under the studs to determine the amount of variation in the work. A straightedge may be placed against two of the studs for laying off lines at right angles or at an angle of 45 degrees to the edge of the work. This tool can also be used for testing the accuracy of machinist's squares.

Washington, D. C. G. A. LUERS

V-END SUPPORT FOR INSIDE MICROMETER

The attachment for an inside micrometer here illustrated permits accurate measurements to be made between size plugs on jig work, where an outside micrometer is not available. The V-end attachment centers the end of the micrometer on one plug, and the high spot on the other plug is easily found. The attachment shown in the illustration is adapted for use on the 32-inch Starrett inside micrometer, and by inserting split sleeves of the correct size, can be used on Starrett and Brown & Sharpe micrometers of smaller size.

Minneapolis, Minn. OSCAR GAALAAS



Support Attachment for Inside Micrometer

Questions and Answers

PATENTS ISSUED JOINTLY

L. K. T.—Suppose that two persons invent something and apply for and obtain a patent. In whose name must the application be filed, and can one of the inventors sell his share without the assent of the other?

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

Where two or more persons work to perfect an invention, the application must be filed jointly, and the patent is issued in their names. And where two men work to perfect an invention, neither can apply for a patent as sole inventor and obtain a valid patent. (227 F. 84).

Furthermore, the law is well established that where a patent is issued jointly to two or more inventors, either has the right to sell his interest, or manufacture and sell the invention, or license others to do so, without permission from the other inventor. (220 F. 905). Therefore, it is a very good idea for joint applicants to enter into contractual relations whereby neither shall make the invention or license others to do so without permission of the other. If this is not done, and the patent is issued to two or more inventors, each of them actually has the same interest and rights in the patent as if only one were named as the patentee. Either one may proceed to market or license the invention without consulting the others, unless there is a contract to prevent it.

PROPERTIES AND USES OF CHROMIUM

A. G. L.—What are the important physical properties and applications of the chromium plating process?

Answered by the Chromium Corporation of America, New York

The chromium plate of the Chromium Corporation of America (known as "Crodon") is ten times as hard as nickel plate and three times as hard as cold-drawn steel. On the hardness scale, it is listed at 9 as compared to the diamond at 10. This hardness is particularly useful where resistance to rubbing action is required. It has already found use on drawing dies and also on mandrels for producing brass, copper, and nickel tubing. One company reported that the life of "Crodon" plated mandrels was twenty-five to fifty times that of their regular heat-treated steel mandrels. Another application where a smooth hard surface is required is on textile equipment, such as thread guides. The printing and pottery industries are using "Crodon" plated dies and have found that they will outwear casehardened ones.

"Crodon" plate has proved useful as a bearing surface. In one case where it was very difficult to keep the bearing from scoring, due to difficulty in oiling, the use of a "Crodon" plated bearing eliminated the trouble. In many places where casehardened thin parts of comparatively large area are now used, the hardening operation could be replaced by "Crodon" plate. This would eliminate the difficulty now experienced in keeping such parts from warping in the hardening process. During plating, the parts are never heated above the temperature of boiling water. Some manufacturers are making use of "Crodon" for building up undersized parts, which would otherwise have to be scrapped.

"Crodon" is not oxidized below 700 degrees F., and will protect steel from scaling at 1500 degrees F. and above. This property is being utilized in pyrometer parts, soot cleaner elements, oil burner parts, oil cracking equipment, and thermostat parts.

"Crodon" is not affected by organic acids, salt water atmosphere, nitric acid, or sulphur compounds. This resistance to sulphur has proved useful in rubber molds and on oil equipment in contact with sulphur bearing oils at high temperatures. [For additional information on this subject, see the following articles previously published in MACHINERY: "The New Process of Chromium Plating," January, 1927, page 398; and "Chromium Plating," February, 1927, page 457—EDITOR]

COMPOSITION OF PHOSPHOR-BRONZE

D. W.—What is the chief element in phosphor-bronze, and to what extent is the composition varied for different classes of service, as for example, when used for bearings, gears, etc.?

A.—Copper is the chief element in phosphor-bronze; the other ingredients are tin and phosphorus, with small percentages of zinc, iron, and lead. For phosphor-bronze of high strength, the following mixture is recommended: Copper, 90 per cent; tin, 9 per cent; five-per-cent phosphor-tin, 1 per cent. The alloy made according to this formula is poured into ingots and then remelted and poured into sand castings. The remelting increases the strength. For ordinary work, when a medium strength is required, and when the scrap is used over and over again, the following mixture is recommended: Copper, 90 per cent; tin, 8 per cent; five-per-cent phosphor-tin, 2 per cent. For phosphor-bronze bearings, the following alloy is often used: Copper, 80 per cent; tin, 8 per cent; lead, 10 per cent; five-per-cent phosphor-tin, 2 per cent. Phosphor-bronze for worms and gears usually contains from 10 to 12 per cent of tin and from 0.7 to 1 per cent of phosphorus. If the wear is excessive, the phosphorus content may be increased to from 1 to 1.5 per cent. Phosphor-bronze resists corrosion to a considerable extent, and is, therefore, used for parts that are exposed to the action of salt water. The tensile strength varies from 20,000 to 30,000 pounds per square inch, with an elastic limit of from 10,000 to 15,000 pounds per square inch, and an elongation of 2 to 6 per cent.

Prize Winners in Mechanism Contest

Seven prizes were offered by MACHINERY in the February and March numbers for the best articles on ingenious mechanisms or mechanical movements.

One hundred and three articles illustrating and describing mechanisms of unusual interest were entered in this prize competition from every industrial section of the United States and from several foreign countries. From the large number submitted, the prize-winning articles have been carefully chosen, the selection being based upon such essential factors as ingenuity of the mechanism and its practicability, as well as the care evidenced in the preparation of the article and the clearness with which the mechanism was described.

Owing to the large number of interesting mechanisms submitted, the number of prize-winning articles was increased from seven to eleven with a view to awarding prizes to four more contestants who submitted articles of more than ordinary merit. The prize-winning articles will be published in MACHINERY beginning with the June number. Most of the articles submitted that did not receive prizes were also of such interest that they will be published in future numbers of MACHINERY.

The prize winners and prizes are as follows:

One Prize—$100

VICTOR ARKIN, 4153 N. Sacramento Ave., Chicago.

Two Prizes—each $50

PHILIP GATES, 164 Blackhorse Lane, Walthamstow, London E 17, England

EARL R. PHINNEY, 101 Spring St., Pawtucket, R. I.

Eight Prizes—each $25

S. H. HELLAND, 113 East St., Whitinsville, Mass.

WILLIAM C. LANDIS, Westinghouse Air Brake Co., Pittsburg, Pa.

F. C. MASON, 311 N. Vermillion St., Streator, Ill.

E. C. OLIVER, Oliver Instrument Co., Adrian, Mich.

D. L. ROBERTS, 996 Mill St., San Luis Obispo, Cal.

GUSTAF SANDBERG, 988 E. 37th St., Brooklyn, N. Y.

HAROLD C. TOWN, 7 Park Ave., Keighley, Yorks, England

I. F. YEOMAN, 1823 Roys Ave., Elkhart, Ind.

The cooperation of so many of MACHINERY'S readers will make it possible to place on record, for the service of thousands of other readers, the useful ideas and suggestions in these articles.

Steel Treating Society's Ninth Annual Exposition

According to information received from the American Society for Steel Treating, 4600 Prospect Ave., Cleveland, Ohio, over 200 exhibitors have made reservations for the exposition sponsored by the society, to be held in the Convention Hall at Detroit, Mich., September 19 to 23. In conjunction with the exposition, four national societies will hold technical meetings in Detroit during the week. The following concerns, manufacturing machinery, tools, and shop equipment, are among the exhibitors:

Acme Electric Welder Co.
Air Reduction Sales Co.
Ames Co., B. C.
American Brass Co.
American Electric Fusion Corporation
American Gas Furnace Co.
Armstrong Bros. Tool Co.
Armstrong-Blum Mfg. Co.
Atkins & Co., E. C.
Ajax Mfg. Co.
Bath & Co., John
Bausch & Lomb Optical Co.
Bearium Bearings Co.
Bellevue Industrial Furnace Co.
Bethlehem Steel Co.
Black & Decker Mfg. Co.
Bourne Fuller Co.
Bristol Co.
Brown Instrument Co.
Buffalo Forge Co.
Carborundum Co. (Abrasive Division)
Carborundum Co. (Refractory Division)
Campbell Co., Andrew C.
Carpenter Steel Co.
Central Alloy Steel Corp'n.
Chambersburg Engineering Co.
Cleveland Twist Drill Co.
Clipper Belt Lacer Co.
Colonial Steel Co.
Colonial Tool Co.
Columbia Tool Steel Co.
Cooper-Hewitt Electric Co.
Cushman Chuck Co.
Danly Machine Specialties Co.
Disston & Sons Co., Henry
Driver-Harris Co.
Edlund Machinery Co.
Firth-Sterling Steel Co.
Gatermau Mfg. Co., W.
General Electric Co.
Gibb Welding Machine Co.
Goddard & Goddard Co.
Halcomb Steel Co.
Hoskins Mfg. Co.
Illinois Tool Works
Jessop Steel Co.
Jones & Laughlin Steel Corporation
Kelly Reamer Co.
Keystone Lubricating Co.
Leeds & Northrup Co.
Leitz & Co., E.
Liberty Machine Tool Co.
Linde Air Products Co.
Ludlum Steel Co.
McGill Metal Co.
Metal & Thermit Corporation
Michigan Tool Co.
Midvale Co.
Morse Twist Drill & Machine Co.
National Machinery Co.
National Twist Drill & Tool Co.
Norton Co.
Nuttall Co., R. D.
O. K. Tool Co.
Pels & Co., Henry
Pittsburg Instrument & Machine Co.
Potter & Johnston Machine Co.
Pratt & Whitney Co.
Procunier Co.
Production Machine Co.
Pyrometer Instrument Co.
Reeves Pulley Co.
Rockwell Co., W. S.
Seneca Falls Machine Co.
Shore Instrument & Mfg. Co.
Simonds Saw & Steel Co.
Skinner Chuck Co.
Standard Tool Co.
Starrett Co., L. S.
Strong-Carlisle & Hammond Co.
Strand Co., N. A.
Stuart & Co., D. A.
Surface Combustion Co.
Taylor Instrument Co.
Thomson Electric Welding Co.
Timken Roller Bearing Co.
Tinius Olsen Testing Machine Co.
Tuthill Pump Co.
Union Drawn Steel Co.
Unishear Co.
Vanadium Alloys Steel Co.
Vulcan Crucible Steel Co.
Waterbury Farrel Foundry & Machine Co.
Westinghouse Electric & Mfg. Co.
Wheelock, Lovejoy & Co.
Whitman-Barnes-Detroit Corporation
Whitney Mfg. Co.
Whitney Metal Tool Co.
Wilson-Maeulen Co.

The Machine-building Industries

THERE is a widespread belief that the volume of business in the United States at the present time is not quite equal to that of the corresponding period last year. It is, therefore, of interest to record that statistical figures covering production indicate that the March output, instead of being less, has exceeded the record-breaking business of last year in several fields. The output of both pig iron and steel was larger than in March, 1926, the March production of pig iron being the largest for any month in two years, and of steel, the largest in over three years. Six additional blast furnaces were blown in during the month, and the United States Steel Corporation was reported early in April to be operating at 96 per cent of capacity.

The output of minerals, which slightly declined in January, has advanced once more to the record level reached last December, and the distribution of commodities by the railroads has also been larger than for the corresponding period of any previous year. It is important to note these facts, as they are based not on mere opinion gathered from the conditions in any one industry, but upon available statistical data covering basic industries and railway operation.

Automobile Industry and Building Activity Show No Tendency to Slow Down

It is generally conceded that industrial activity will remain at a high level as long as the building and the automobile industries continue to operate at their present rates. *Commerce and Finance* points out that the predicted slump in the building industry has failed to materialize. Construction contracts reported by the F. W. Dodge Corporation from thirty-seven states east of the Rockies totalled over $620,000,000 for March, exceeding the previous high record of August, 1925, by $9,000,000. The *Engineering News Record* points out that engineering construction work is proceeding at practically the same rate as the average for 1926.

Reports based on specific figures of automobile production do not substantiate the somewhat pessimistic rumors that have been abroad. General Motors, Studebaker, and Hudson, for example, all report unusual activity and active sales. Studebaker broke all production records in March with an output of 17,238 cars. The General Motors Corporation equalled, if it did not exceed, its previous high record of 141,650 cars established last May. April schedules run higher than March, and with the exception of two of the largest producers, the output in April may reach record figures.

The Machine Tool Industry Continues to Hold Its Own

In the machine tool industry, while neither shipments nor orders during March, 1927, equalled the unusually high figures for March, 1926, it should be noted that since January, orders have been climbing and shipments have increased, statistics indicating that the orders during March were, on an average, well in excess of those for the month of February. The activity in the industry, however, is spotty, some plants finding business quiet, while others are operating at a greater rate of output than at any time since 1920. Competition is very keen, and present prices leave but a narrow margin of profit, if any.

The business in medium and small presses is quite active, with demand somewhat less for heavy presses and shears. The automatic refrigerator business will mean a great deal to press manufacturers, because as this industry is developing into large proportions, more and more press equipment will be required. A very large proportion of the parts in many of these refrigerators are made from pressed metal. Last year 200,000 automatic refrigerators were made and sold, and the schedules for this year indicate that 600,000 will be manufactured.

Conditions in the industrial truck business are not satisfactory. There are a great number of competitors in this field, and the demand is not sufficient to engage the productive capacity of all the plants building industrial trucks. Each manufacturer also makes a great number of different types and sizes to suit various requirements, making it difficult to produce in quantity or to standardize with a view to reducing production costs.

Exports of Industrial Machinery Increase

The exports of industrial machinery from the United States during February, the last month for which complete statistics are available, amounted, according to the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, to $12,275,000—an increase of more than $1,225,000 over the shipments for the corresponding month in 1926. Owing to the fact that February is a short month, with two holidays, the exports during that month are usually less than in the month of January, but the significant fact is the large increase of the shipments over the corresponding month a year ago. Exports of power-driven metal-working machinery increased from $976,430 in February, 1926, to $1,121,250 in February, 1927. Exports of several other lines of industrial machinery and equipment showed a large gain over the corresponding month of 1926.

Exports of machine tools increased nearly 20 per cent in the first two months of this year, as compared with the same months last year. The total value of machine tools exported in January and February, 1927, was $2,616,700. The increases affected almost every line of machine tools, including, for example, engine and turret lathes, vertical boring mills and chucking machines, automatic screw machines, milling machines, drilling machines, planers, shapers, slotters, and grinding machines.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

COMTOR MEASURING AND INSPECTING INSTRUMENTS

More than five years have been spent by the Comtor Co., Box 215, Waltham, Mass., in the development of an inspection system to meet the needs of quantity production manufacture of interchangeable parts. Various instruments have now been placed on the market for measuring and inspecting outside and inside diameters of parts. The system includes not only measuring instruments, but also means for producing working reference standards and a flexible-unit means for storing, identifying, charging out, and checking the shortage of ring, disk, and gage-block standards while caring for the continuous growth of the equipment in new and duplicate sizes.

All instruments of the system are of such design that the gaging or contact surfaces are automatically applied to the reference standard and to the work by a uniform spring pressure. This construction eliminates the human factor in the adjustment and use of an instrument. All other measuring errors, problems of gage tolerance, wear, and upkeep, and danger of misreadings are eliminated by keeping the instrument adjusted to the reference standard. The anvils square themselves automatically on work, and insure precision of measurements. Flat anvils and other contact surfaces are made of tool steel, hardened, tempered, seasoned, lapped, and tested by the light-wave method.

Fig. 1 shows the type O "Comtorgage" which is intended for measuring outside diameters. In grinding operations, it may be held on the revolving work while grinding is in progress. The anvils can be reversed or inverted into four new wearing positions. Automatic adjustment of the center stop is obtained by setting the upper arm. Fig. 2 shows the "Comtorgage" equipped with special anvils for measuring the diameter at a given point on a tapered part.

This instrument is well adapted to measuring the depth of screw threads by the three-wire method. The wires are easily slipped into place and automatically held, and the light uniform spring pressure contributes toward correct and uniform results. By using a special cylindrical reference standard and "best wires" (wires making pitch-line contact), the pitch diameter of the thread may be read directly on the "Comtorgage" dial without computation.

A type I "Comtorgage" is made for measuring holes more than 2 inches in diameter. This instrument is similar to that shown in Fig. 1, with the exception of the arms and anvils. The center stop is omitted and the spring reversed.

Holes under 2 inches in diameter may be measured by means of the "Comtorplug" illustrated in Fig. 4. This instrument is contracted by hand and released in the hole, where it is expanded by the spring. Different sizes of interchangeable expansion plugs fit the amplifier casing.

Fig. 3 shows a "Comtorslide." The jaws of this instrument can be adjusted on gage-blocks, a cylindrical standard, or a rod gage, and the inside type of Comtor instrument may then be set between the jaws. The use of this instrument eliminates the need of special large reference ring gages. It may be mounted vertically or at any angle, and can be taken to a machine for checking a "Comtorgage" or "Comtorplug." The anvils can be turned to give four new wearing surfaces.

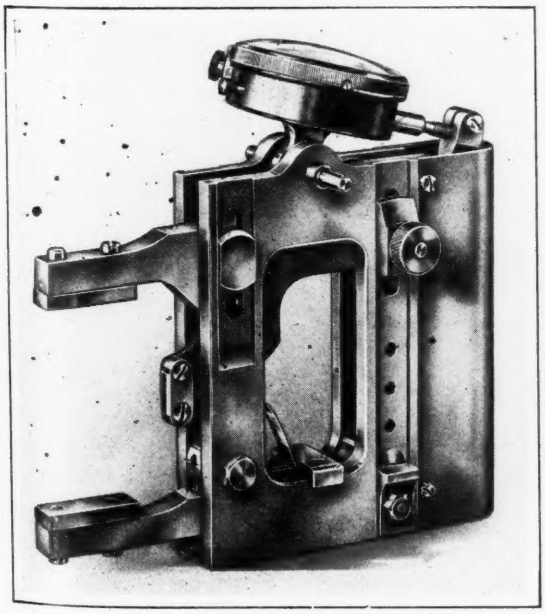


Fig. 1. "Comtorgage" Intended for Accurately Measuring Outside and Inside Diameters

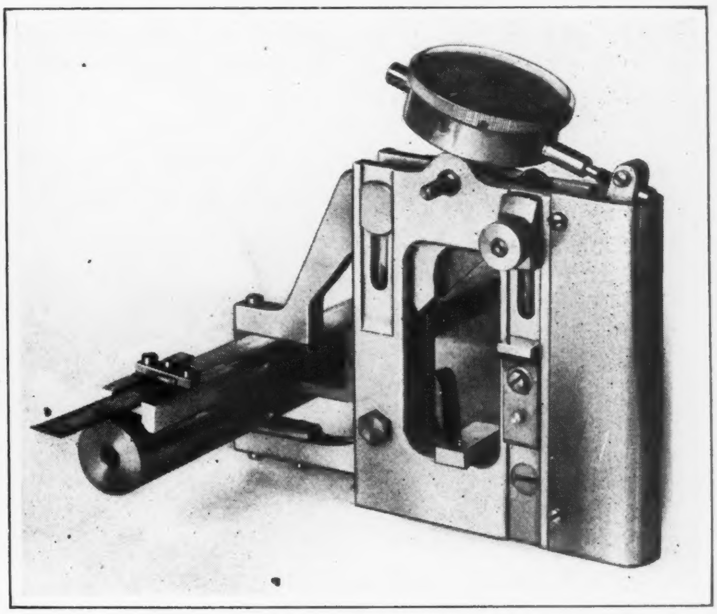


Fig. 2. Employing the "Comtorgage" for Measuring the Diameter of a Tapered Spindle at a Given Point

Small sets of precision gage-blocks termed "Comtorblocks" can be furnished for use in measuring all standard sizes of holes. For special holes, the usual decimal set of precision gage-blocks is employed.

Reference standards may be stored in the "Comtorbox" illustrated in Fig. 6. This box is of a flexible-unit construction in which there are pairs of easily removable interchangeable rails. The suspended bottom support is adjustable for elevating any standard to a convenient level, and

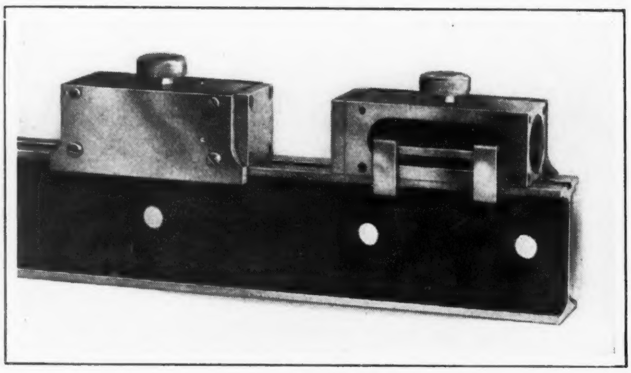


Fig. 3. "Comtorslide" which Eliminates the Need of Large Reference Ring Gages of Special Design

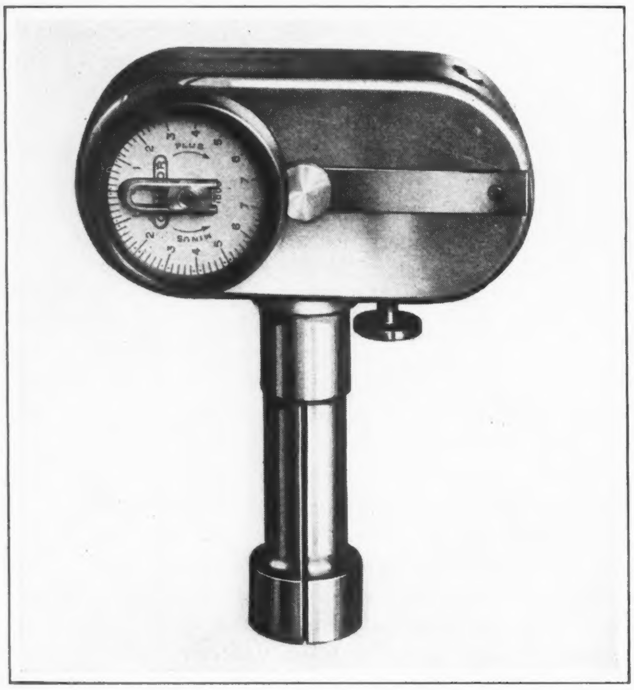


Fig. 4. "Comtorplug" Used for Measuring Holes Less than 2 Inches in Diameter

Fig. 5. "Comtorstand" Used for Holding Working Reference Standards

the complete unit with its load may be lifted out and transferred. Identification clips may be clamped where required, and identification plates slipped into place under "windows." The reference standards are arranged in the order of increasing diameters. Workmen's checks are deposited for standards issued, and if the complete space is not filled or accounted for, a loss is indicated. In the Comtor System, where the reference standard is a working element, such a means of caring for the standards is necessary.

Another instrument included in this line is the "Microcomtor," previously described on page 913 of July, 1923, MACHINERY. This instrument is intended for use in producing working cylindrical standards that are plus or minus the fit differences over or under the basic or master disk. It is not an essential part of the Comtor System, and is not needed by those who prefer to order all working standards from gage specialists. The "Microcomtor" is graduated to 0.0001 inch, and can be easily read to 0.00005 inch or closer.

The "Microcomtor" comprises a spring-operated micrometer screw which is geared to a retarding fan through an absorbing clutch. An automatic brake which is operated from a center stop locks the instrument before it is removed from the work. The driving, retarding, absorbing, and locking mechanism is simple and sturdy.

Fig. 6. "Comtorbox" Used for Storing Reference Standards

Fig. 5 shows a "Comtorstand" which is a convenient means of supporting cylindrical working reference standards at a machine tool in such a way that the standards are kept at the temperature of the room and do not become distorted or expanded by handling. Other instruments and appliances are also made for the Comtor System.

VICTOR RECEDING-CHASER TAPS

A line of style M receding-chaser collapsible taps, designed for cutting taper threads in tool joints, casing shoes, pipe couplings, flanges, valve bodies, fittings, etc., has been placed on the market by the Victor plant of the Landis Machine Co., Inc., Waynesboro, Pa. The new line replaces the present style in 4-inch sizes and larger. Three groups of these taps are made, each group employing one body with a series of detachable heads.

The body of Group I is 4 inches in diameter, and may be provided with heads for cutting threads from 4 1/2 to 5 3/4 inches outside diameter. Group II taps are provided with a 5-inch diameter body, and may be furnished with heads for cutting threads from 6 1/2 to 13 3/8 inches outside diameter. The body furnished with Group III is 7 inches in diameter, and may be equipped with heads for cutting threads from 13 3/8 to 24 1/2 inches outside diameter.

The body of this style M tap includes a cam collar, cam slide, cam plunger extension, expanding collar, trip-ring rods, and minor details, while the head includes a plunger, chaser blocks, chasers, tap, and trip-ring. The head is ground all over, including the seat of the chaser block slots, and is bolted to the flanged end of the body by means of hollow-head screws placed in the bottom of the chaser block slots. Ground surfaces on both the head and body insure alignment, and a key takes the driving strain.

The chaser blocks are ground all over, and are interchangeable among the different heads. Chaser threads are ground after hardening, to insure accuracy of form and lead and maximum service. The number of chasers used per head is on the basis of one per inch in the even number sizes. Odd number sizes have the same number of chasers as the next smaller even-number size. Chasers can be supplied for cutting any form of thread, being regularly furnished for the A.P.I. standard threads employed in oil fields.

The trip-ring is hardened and ground on account of the fact that it comes in contact with the work during the tapping operation. The holes for attaching the trip-ring rods are so placed that the same rods will fit all rings in the same group, a separate trip-ring being required for each size of head. Special-length bodies can be furnished to suit jobs requiring threads longer than the standard length of 4 1/2 inches provided by the tap, or for reaching through a recess to the beginning of a thread.

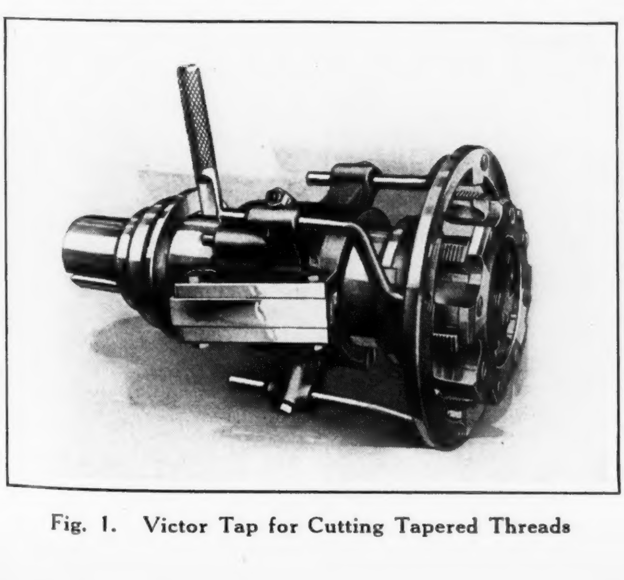


Fig. 1. Victor Tap for Cutting Tapered Threads

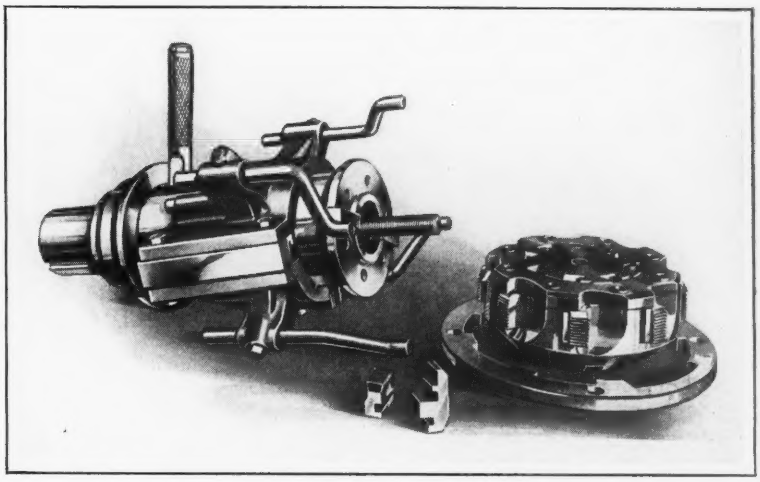


Fig. 2. Disassembly of the Tap Body and Head Units

The cam collar is a semi-steel casting carrying a cam slide and cam. Its position on the body and the distance that it moves along the body determine the length of thread being cut. A special cam collar is required for cutting threads longer than the maximum length provided by the tap. The cam slide is inserted in the top of the cam collar and carries the cam as the collar recedes. The top of the cam is milled to provide for cutting any two tapers of thread by proper pivoting in the slide. The cam works between two hardened tool-steel gibs inserted in the tap body. Angular surfaces are milled on the sides of the cam to contact with the plunger extension. A downward movement of the cam, imparted by the cam collar and slide, causes the plunger to recede, and, in turn, draws the chasers in, thus producing a tapered thread.

The purpose of the expanding collar on the tap is to expand the chasers and set the cam collar in the tapping position when the tap is rotated. A straight forward or downward pressure against the collar accomplishes this, the pressure being usually caused by a yoke ring engaging the collar on the return movement of the spindle while the tap is in motion. This collar also constitutes a positive collapsing feature when the cam collar strikes it on the completion of a thread.

The style M tap is regularly furnished for cutting tapers of 3/8 and 3/4 inch per foot, and any combination of the two tapers can be provided. A change from one taper to another can be made in from five to ten minutes. Size adjustment of the chasers is obtained through a screw in the front end of the plunger. There is an adjustment of approximately 1/8 inch over or under size available on each head.

The new tap can be used either as a rotary or as a stationary tap. When used as a stationary tap, it is expanded by hand through the operating lever, but when used as a rotary tap, this lever is removed and the expanding collar is employed.

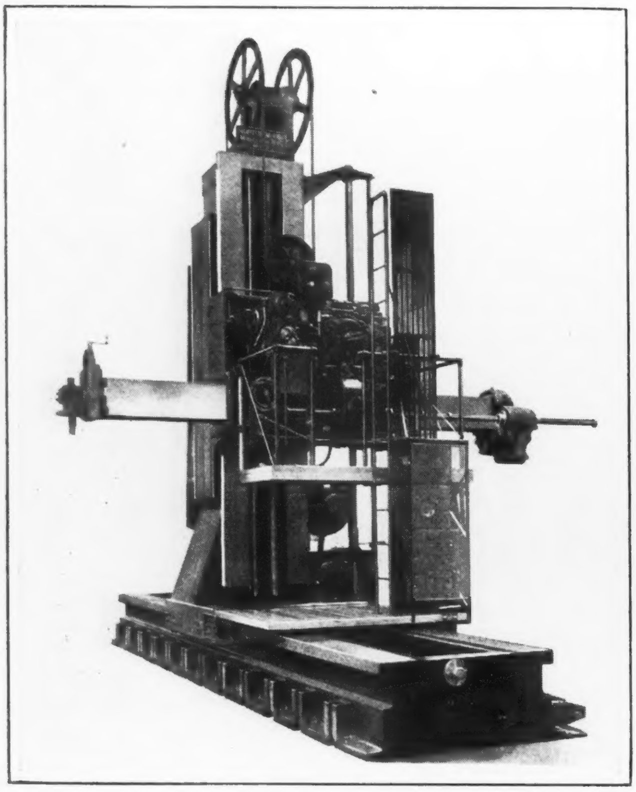


Fig. 1. Morton Draw-cut Planer with Traveling Head

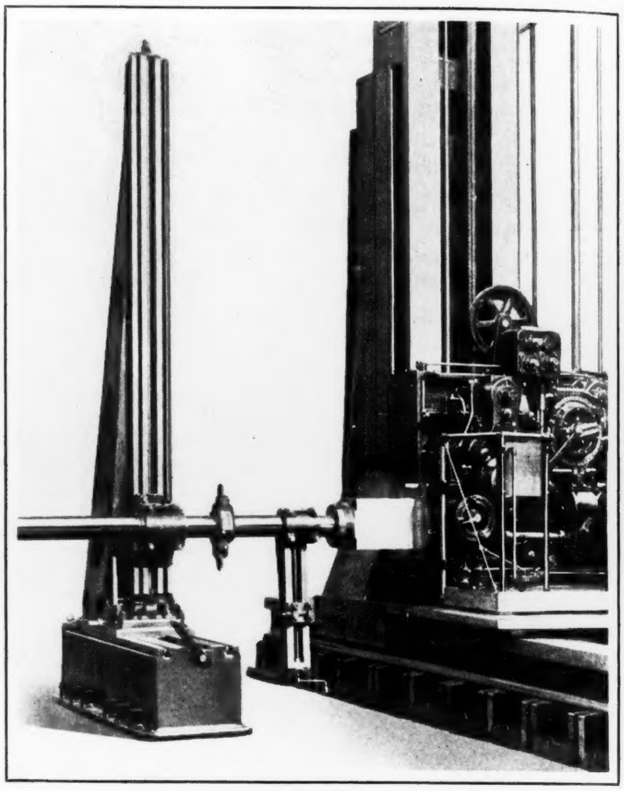


Fig. 2. Planer Equipped for Boring and Facing

MORTON DRAW-CUT TRAVELING-HEAD PLANER

The latest 84-inch stroke draw-cut traveling-head planer to be built by the Morton Mfg. Co., Muskegon Heights, Mich., is shown in the accompanying illustrations. This machine may be equipped with floor plates, work-tables, a milling attachment, a right-angle boring attachment, standard and traveling-head boring-bars with an outer support for the bars, a reversible head for either push or pull cuts, push- and pull-cut slotter bars, and special equipment to meet particular needs. The machine is arranged either for stationary or portable use, the bottom of the bed being machined. It is reversible and may be quickly changed into a large horizontal traveling-head slotter.

Fig. 3 shows the machine arranged for a vertical milling operation, while Fig. 2 shows it equipped with a boring-bar, cutter-head, facing arm, and outer bearing support. Milling and boring feeds are quickly changed to meet conditions. Parts can be milled vertically and bored at right angles with the ram, at any 90-degree point of an arc. Many operations may be accomplished in one setting of the work, resulting in a large saving of time. All control levers are within easy reach. A special offset boring head can be furnished for mounting on the end of the ram similarly to the milling head seen in Fig. 3.

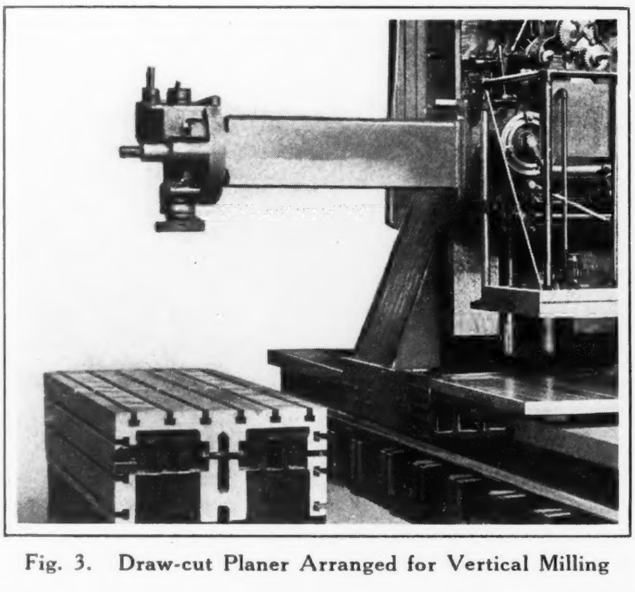


Fig. 3. Draw-cut Planer Arranged for Vertical Milling

Draw-cut traveling-head planers are also regularly built with a cutting stroke of 60 and 72 inches and with any column height and bed length. Larger machines can be built for special work. The manufacturer states that these planers occupy only one-half the floor space and require only one-third the power of a housed planer of equal capacity. The planers are especially adapted for completely machining rolling-mill castings; engine beds; and air-compressor, refrigeration, and turbine castings. Large flywheels and gears may be readily keyseated, and the general run of heavy repair work encountered in steel mills and contract shops may be handled.

BADGER DOUBLE-SPINDLE GRINDER

Important improvements have been made in the design of the No. 224 grinder built by the Badger Tool Co., Beloit, Wis., since the description of this machine was published in July, 1925, MACHINERY. The machine is of the double-spindle type, and is used for grinding two opposite parallel surfaces of work. It carries two 24-inch diameter cylinder wheels which are mounted in chucks. Each wheel is driven by a 20-horsepower motor connected to the spindle through a flexible sliding coupling.

The work-table, on which suitable fixtures are mounted, is reciprocated in and out between the grinding wheels by

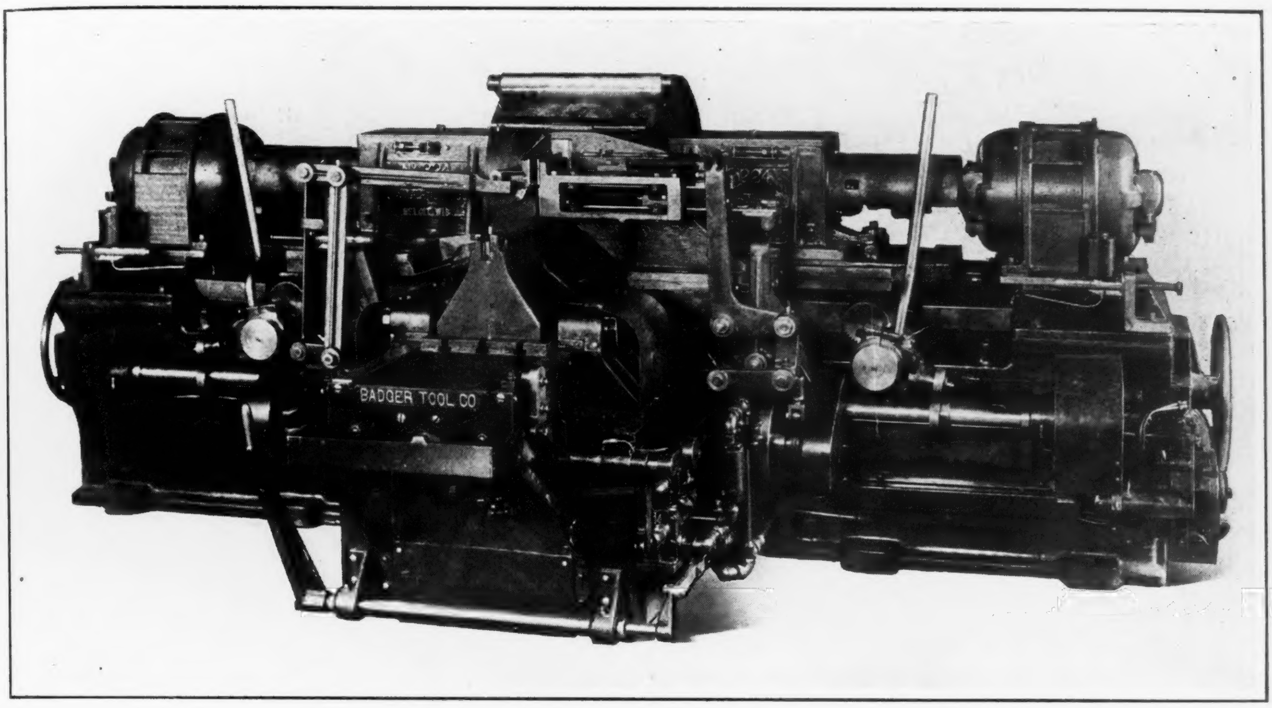


Fig. 1. Badger Double-spindle Grinder of Improved Design

means of a hydraulic system. Through the use of automatically operated cams and valves virtually any desired table travel can be produced in a simple manner. The grinding wheel heads automatically open and close in proper relation to the cross travel of the table. For long cuts, a gradual in feed of the heads is provided, and in all cases, micrometer stop-screws are furnished for each head so that duplicate sizes can be obtained on work on a production basis.

One of the most recent developments of this machine is a new spindle and head construction. As may be seen in Fig. 2, the spindle proper is a one-piece forging, which is turned and ground all over. The front or inner end of the spindle is carried in a tapered bronze bearing, and the rear or outer bearing has a tapered sleeve which is keyed and adjustably locked to the spindle. This sleeve also revolves in a tapered bronze bearing. End thrust is taken on a large hardened and ground steel collar, which bears against the wide flange on the inner end of the bronze bearing bushing. Adjustable collars afford means of taking up end play. The flanges to which the wheel chucks are attached are 11 inches in diameter by 2 inches thick.

An interesting feature of this head construction is the self-contained lubricating system, the head serving as an oil reservoir. The small circulating pump, seen near the middle of the head in Fig. 2, is completely submerged in oil and driven by a gear which engages with the pinion cut in the central portion of the spindle proper. Oil is pumped to the distributing compartment through strainers and a glass sight gage on the front of the head, and then through copper leads to each radial and thrust bearing. Both spindle bearings are thoroughly sealed with specially designed labyrinth joints to exclude grit and prevent oil leakage.

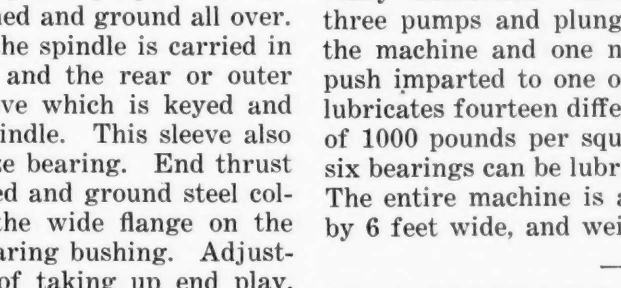


Fig. 2. Disassembled View of New Head

A strainer is attached to the under side of the cover plate, and new oil put into the head passes through this strainer. It also passes through a second and finer screen. The bearings are flooded with finely filtered lubricant.

Another feature of this grinder is the application of a centralized lubricating system for all bearings other than those of the main spindle already mentioned. In Fig. 1 there may be seen three pumps and plungers, one near each end of the machine and one near the middle. A single push imparted to one of these plungers positively lubricates fourteen different bearings at a pressure of 1000 pounds per square inch. A total of fifty-six bearings can be lubricated in about ten seconds. The entire machine is approximately 14 feet long by 6 feet wide, and weighs 20,000 pounds.

NILES-BEMENT-POND BORING AND TURNING MILL

A large vertical boring and turning mill, embodying many improved features, has recently been built by the Niles Tool Works Co. Division of the Niles-Bement-Pond Co., 111 Broadway, New York City. This machine has a capacity of 18 feet between the housings, and is of considerably heavier proportions than previous types. The table is supported by the bed on double annular tracks. One of these tracks is as near as possible to the table drive gear, and the other is close to the

table spindle, so that the load and bearing pressures are distributed over the full area of the table.

Forced lubrication is provided for the table tracks and spindle, the oil being forced to the bearings beneath the table and returned to the main reservoir in the foundation. The drive to the table is delivered through a totally enclosed gear-box in which all gears dip in oil. Shafts and bearings are generously lubricated from the same source.

The cross-rail is of an entirely new square-box design, the section between the housings being uniform throughout its length. The clamping surface extends back considerably between the housings to give a rigid construction. A stiffener or camber beam of deep section is attached to the cross-rail to correct any deflection in that member. In addition to the top brace, the upper structure is further strengthened by the large built-up girder seen in Fig. 1.

Elimination of considerable mechanism on the top of the machine has been effected by providing a separate motor at each end of the rail for providing the rapid traverse of saddles and bars. The only mechanism on the top brace is the motor and drive gearing for elevating and lowering the cross-rail. Feeds are obtained through gear-boxes having sliding gears running in oil. The feeds are independent and reversible for each head. Feeds and rapid-traverse movements of bars and saddles are engaged or disengaged by means of large friction clutches on the ends of the rail.

The right-hand head is equipped with special gearing through which the saddle and bar feed may be engaged simultaneously for cutting tapers from the horizontal. Change-gears permit variation of these tapers. The bars and saddles are equipped with direct-reading micrometer dials which are graduated in inches and thousandths of an inch to show at a glance the amount of movement these members have made in relation to the reading when the feed or rapid traverse was first engaged.

Another feature of interest is an adjustable limit switch at the top of the housings, which automatically shuts off the motor when the cross-rail

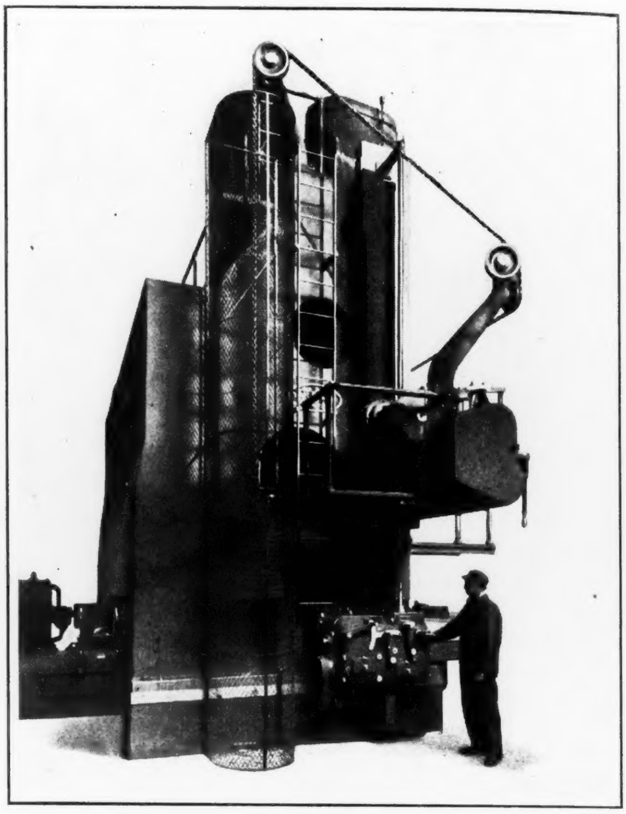


Fig. 2. Left-hand End of Large Boring and Turning Mill

reaches the limit of its travel. Convenience of the operator has been taken into consideration by the duplication of operating levers at the saddles and ends of the rail, and by providing a platform on each saddle, at each end of the cross-rail, and around the top brace. The different platforms are accessible by means of steel ladders, and are protected by railings. The counterweights are enclosed in guards made of steel-wire mesh.

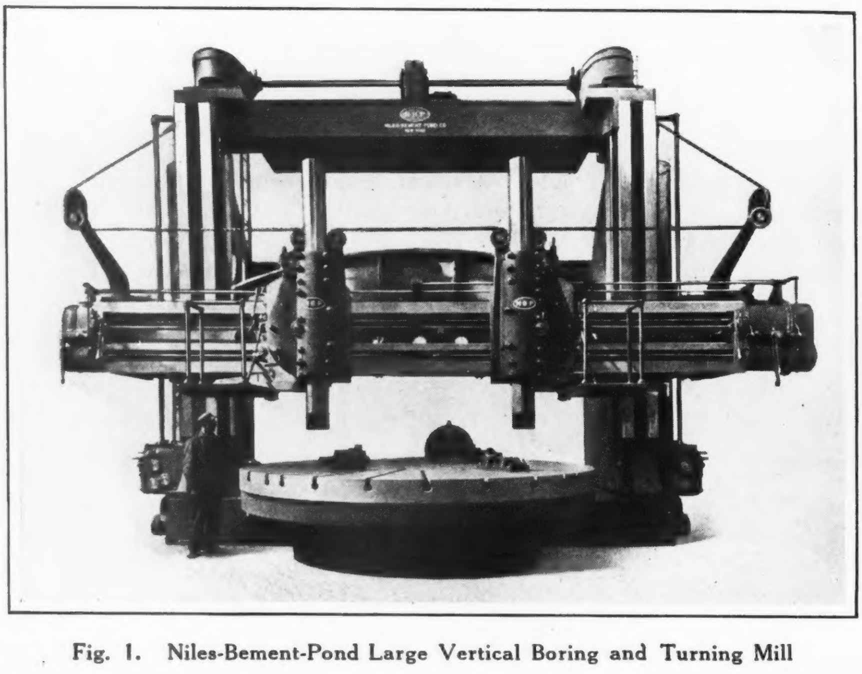


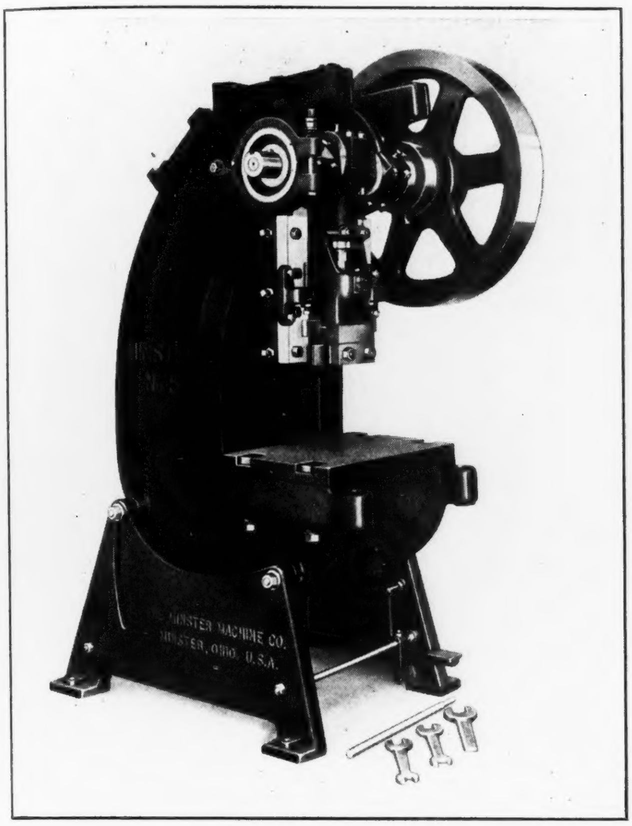
Fig. 1. Niles-Bement-Pond Large Vertical Boring and Turning Mill

MINSTER INCLINABLE POWER PRESSES

Open-back inclinable power presses are being introduced on the market in six sizes by the Minster Machine Co., Minster, Ohio. The different sizes range from 1000 to 8700 pounds in weight and from 12 to 56 tons in ram pressure. Flywheel and back-geared types are built, the flywheel type being shown in the accompanying illustration. When an individual motor drive is desired, either a belted or a direct-geared drive can be furnished for both types.

All castings of the frame are made of semi-steel, and the points subjected to the greatest strain are reinforced to give maximum strength for the casting weight. Lugs are cast on the three largest sizes, so that tie-rods can be used to increase the rigidity of the frame when necessary. Long bearings of large diameter are provided.

The slide is long and moves in heavy gibs which are scraped to an accurate fit. An adjustment is



Minster Open-back Inclinable Power Press

provided to take up wear. Punches are held in the slide by means of an adjustable cap which is clamped with studs that extend through from the back of the slide. Lugs cast on the side facilitate the fastening of wide punches, a stripper, or attachments. There is a positive cross-bar knock-out in the slide, and knock-out brackets are attached to the frame.

The crankshaft is made of a hammered high-carbon steel forging, and is solid with the enlargement for the clutch. The cross-sectional area of the pin bearing is 40 per cent greater than that of the main bearings. The bearings in the frame are overhung, so that the upward thrust of the crankshaft is centered in the solid casting and not borne by the caps. There is a wide and large bearing on the crankshaft for the pitman.

The clutch is of an improved sliding dog type. It provides a positive stop for the crankshaft in case of brake failure, so that the press cannot repeat unless the treadle is held down. A safety pin in the clutch permits dies to be set while the flywheel is in motion. The brake that controls the crankshaft is of simple design and easily adjusted. It is provided with non-burning lining.

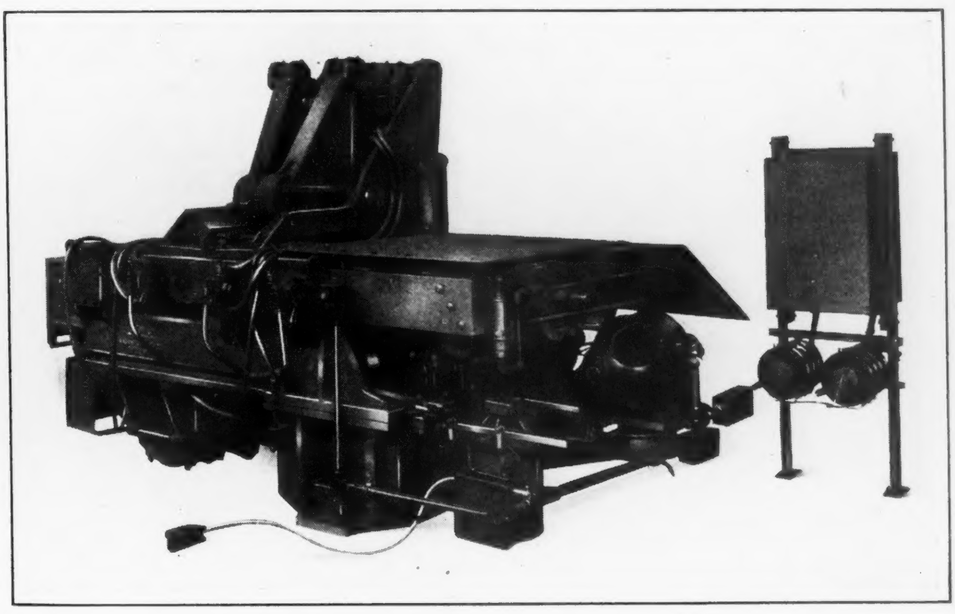
The flywheel has long bronze-bushed bearings which may be oiled while the flywheel is running. There are two hardened striking pins. The backing pins are tapered, so that the clutch dog is gradually brought into full contact. The pitman connection is of the ball screw type, the screw being rigidly clamped in the pitman and being of a large diameter with a hexagon milled at the end of the thread to permit adjusting the slide with ease.

Raising or lowering of the press frame is accomplished by means of telescoping screws, the supporting trunnions on the frame being so located that the height from the floor to the center of the dies does not change materially when the press is inclined. All working surfaces are provided with means for ample lubrication. A safety trip attachment can be furnished to make it necessary for the operator to lift his foot after each revolution of the crankshaft. This attachment automatically safeguards against accidents due to the failure of the operator to remove his foot from the pedal. The motor speed of all flywheel types of these presses is 900 revolutions per minute, and of the geared types, 1200 revolutions per minute.

FEDERAL HEAVY-DUTY RIM WELDER

The latest development of the Federal Machine & Welder Co., Dana Ave., Warren, Ohio, is the No. 110 heavy-duty rim welding machine here illustrated. This machine has a capacity for welding rims up to 1/2 by 18 inches. It is equipped with a 225-kilowatt flash-proof welding transformer; air-operated clamps; and a mechanical push-up device for applying final pressure when the metal is properly heated.

A fully automatically controlled motor, which starts and stops as required, eliminates all clutches and clutch-operating mechanism. After the work has been clamped by means of the air-operated clamps, the operator merely presses a starter button to cause the motor to make a complete cycle and stop at the required time and place. When it is more convenient, the starter button can be operated through a foot-switch. A three-phase induction motor is usually furnished.



Federal Heavy-duty Rim Welder

In the large types of machines, where the work varies over a considerable range in cross-section, it has proved desirable, if not necessary, to vary the speed of the movable platen according to the nature of the work. It is equally important to vary the amount of travel at will. This is accomplished on the new machine through the use of a direct-current adjustable-speed motor. A speed variation of 1 to 3 has proved sufficient in most instances.

The motor reverses its direction of rotation with the reversal in the direction of the push-up platen travel, and the amount of platen travel is governed by the amount of rotation of the motor. The speeds of the forward and reverse strokes are each governed by its respective field rheostat. The forward speed is suited to the work, and the platen is returned to its starting point by the highest return speed.

With this arrangement, a long or short duration of flash can be combined with a short or long travel of the platen. Tests have shown that even two seconds of variation in the time of flashing, on either side of the proper duration, considerably affects the quality of the weld. By pushing up the welding energy and increasing the secondary welding voltage, the time required for making a good weld can be materially reduced. By following this principle, production has been increased 35 to 40 per cent in some instances, and much more in other instances.

BAKER HYDRAULIC BORING AND DRILLING MACHINE

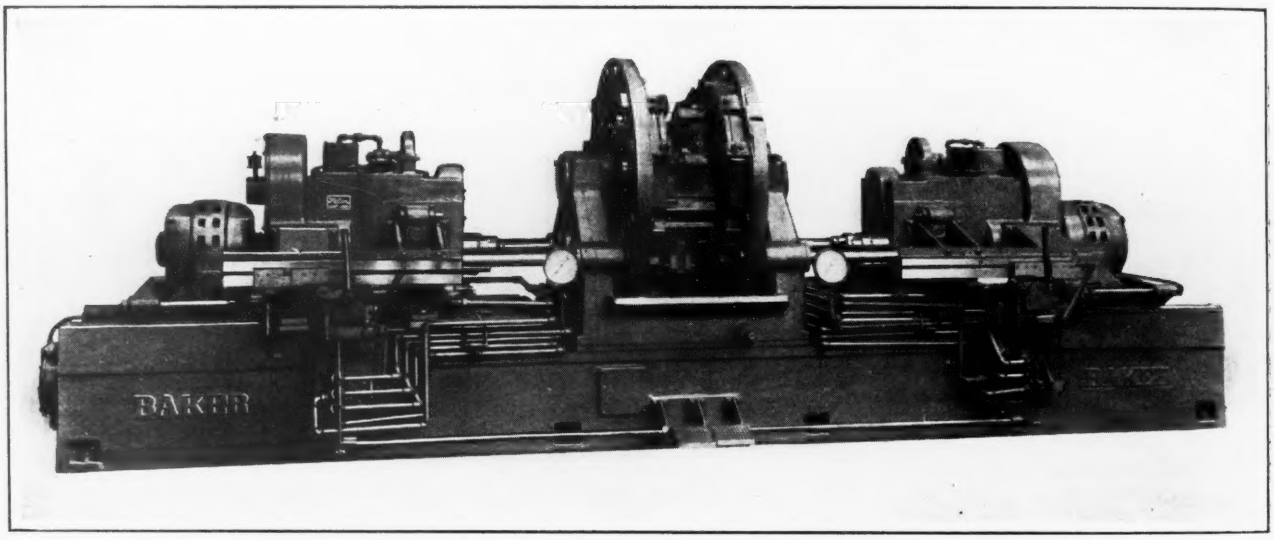
A large multiple-spindle two-way horizontal boring and drilling machine equipped with an Oilgear hydraulic feed constitutes the latest development of Baker Bros., Inc., Toledo, Ohio. This machine is shown in the illustration equipped with a fixture and tools for simultaneously boring the idler shaft, main shaft, and countershaft bores of two transmission cases.

The heads on the ends of the bed slide on wide scraped ways. Each head is driven by a direct-connected motor mounted on the saddle, and is fed through the Oilgear hydraulic mechanism, a cylinder of this mechanism being mounted on both sides of each head. There is an independent Oilgear pump for each head, both pumps being driven from one motor mounted at the back of the machine.

Independent adjustments are provided for the spindles to take care of tool grinding. All gearing and bearings in the heads are lubricated by a pump located on top of each head and connected by gearing to the drive shaft of the head.

The fixture is mounted on Timken bearings and is indexed by hand. At the bottom of the fixture, the frame is cored out, so that chips from the boring operation fall inside the main frame on screw-type conveyors that carry them to one end of the machine.

In the operation of this machine, the operator chucks the work, indexes the fixture, and starts the feed of the heads by depressing the foot-treadles. There is a treadle for each head, but both heads can be engaged at the same time. The heads have a rapid traverse until the cutters engage the work, after which they feed quickly through at any predetermined rate. They automatically and rapidly withdraw from the end of the work at the end of the operation. Control levers are placed in convenient positions so that the machine can be stopped at any time in case of emergency.



Baker Horizontal Duplex Boring and Drilling Machine with Oilgear Feed

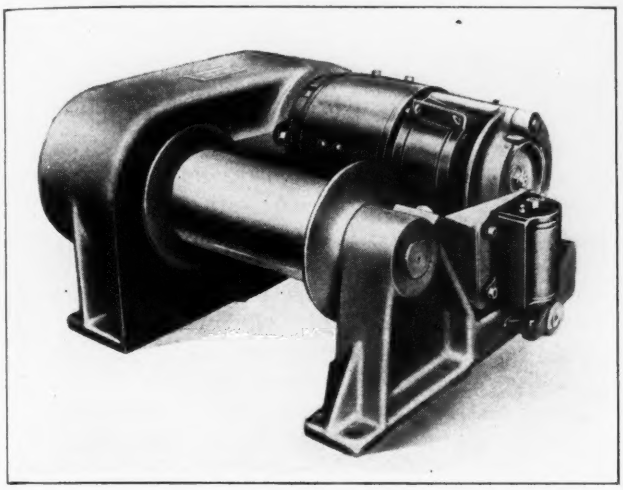
The machine can be modified within wide limits to adapt it to work of different character but embodying the same principles as this specific installation. As illustrated, the weight of the machine, complete with the fixture, is approximately 13 tons.

"LO-HED" ELECTRIC HOIST

A new "Lo-Hed" electric hoist, which may be mounted either overhead or on the ground in a fixed position, or on skids for portable use, has been brought out by the American Engineering Co., Philadelphia, Pa. This hoist is furnished in different sizes for handling loads from 500 to 4500 pounds. The standard equipment consists of a smooth drum driven by a motor through a train of spur gears, all mounted on a common bedplate. The motor and gears are completely enclosed, the gears running in an oil bath. Hyatt roller bear-

ings are mounted on the ends of all gear-shafts. The gear-case cover is easily removed.

Large flanges on the drum prevent the rope from jumping off the ends and give maximum stowage capacity. One bearing of the drum shaft is lubricated by oil splashed from the gears, and the other bearing through an "Alemite" fitting. The motor is equipped with ball bearings and is especially designed for hoist service. Either a direct- or alternating-current motor can be provided. The controller is of the single-speed reversing drum type. Various modifications can be made in the hoist, such as grooved drums, air or steam motors, push-button and remote control, holding and lowering brakes, extension shafts with additional heads, etc.



"Lo-Hed" Electric Hoist Intended for Fixed or Portable Use

INGERSOLL ADJUSTABLE WORK CHUCKS

The accompanying illustrations show the construction and application of adjustable work chucks recently brought out by the Ingersoll Milling Machine Co., Rockford, Ill. These chucks are intended to simplify the setting up of pieces, especially those of irregular shape, for heavy cuts. They are provided with hardened steel jaws which have ground surfaces finished to a standard height above the base, so that the chucks can be used not only for holding and clamping the work, but as parallels for locating the work in an exact position. The jaws are provided with serrated teeth on three faces, to make it convenient to clamp work of different forms and shapes.

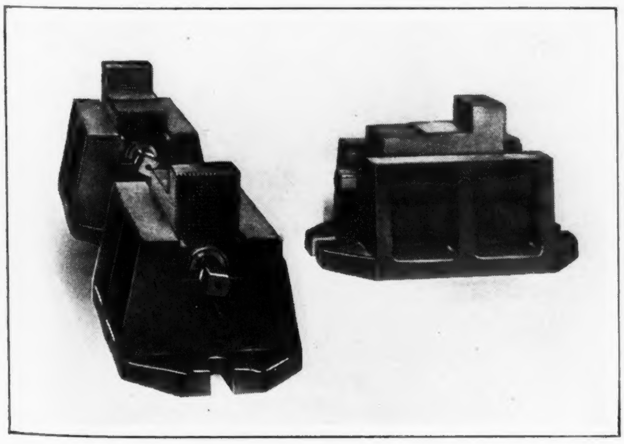


Fig. 1. Ingersoll Adjustable Chucks for Use on Various Machines

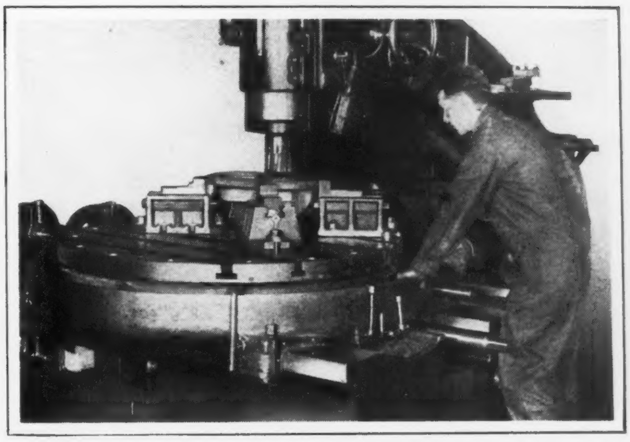


Fig. 2. Holding an Irregular-shaped Casting

The chucks are of heavy construction, each unit being approximately 12 inches long, 8 inches high, and 8 inches wide, and while they may be used for small castings, they are especially suitable for the heavy work met with in the use of such machines as adjustable rail-type milling machines.

Fig. 2 shows a casting of irregular shape held by the chucks on an adjustable rotary milling machine. This would be a difficult set-up by any other method. No special clamping arrangement is required, as the chuck jaws hold the work with sufficient firmness for the cut to be taken. Fig. 3 shows the application of the chucks to heavy work on an adjustable rail-type milling machine.

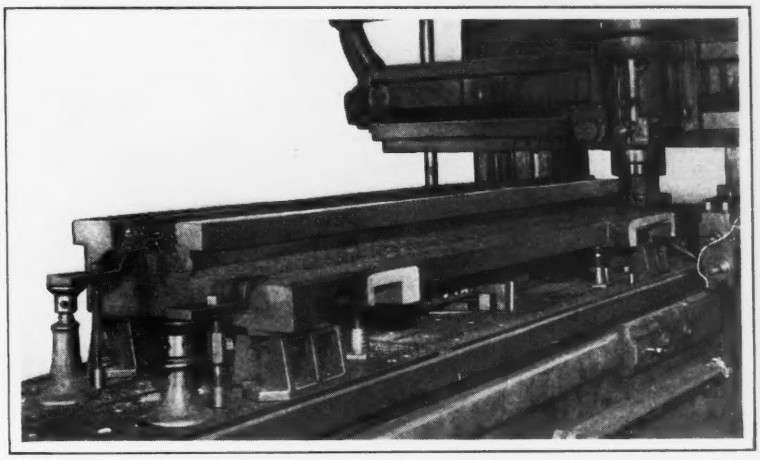


Fig. 3. Employing the Chucks on a Rail-type Milling Machine

BLANCHARD REAMING MACHINE

A power-driven machine designed for hand-reaming holes from 1 to 3 inches in diameter and for removing burrs has recently been developed by the Blanchard Machine Co., 64 State St., Cambridge, Mass. This machine is particularly useful in assembling departments for removing burrs and for the final sizing of holes in bushings. It is also of use in lathe and turret-lathe departments for accurately sizing machine-reamed holes before parts are placed on arbors for further machining.

Blanchard Power-driven Machine for Hand-reaming and Burr-removing Operations

The machine is applicable to any work of a size that can be easily handled.

The reamer is held vertically in this machine, and is rotated at either of two speeds—21 or 38 revolutions per minute. The work is held by hand, either directly or by means of a suitable wrench. Since the operator merely holds the work stationary while the machine supplies the power, the operation is not fatiguing, and a much larger quantity of work can be handled than by ordinary hand-reaming. At the same time, there is no loss of accuracy, as the work is free to allow the reamer to follow the hole.

Large pieces may be grasped with the hands at opposite sides, while small pieces are best held with a double-handle wrench. Heavy pieces or pieces having much weight at one side may be counterbalanced by means of a spring attached overhead or through a cord and counterweight. Equipped with an alternating-current motor, the machine weighs 750 pounds, and when a direct-current motor is supplied, it weighs 820 pounds. The height to the top of the chuck is 37 1/4 inches.

GRAND RAPIDS UNIVERSAL CUTTER AND TOOL GRINDER

The latest development of the Gallmeyer & Livingston Co., 344 Straight Ave., S. W., Grand Rapids, Mich., is a No. 5 heavy-duty motor-driven universal cutter and tool grinder. One of the features of this machine is that transverse, vertical, and longitudinal movements can be obtained either from the front or the rear. With the operator standing in front, the longitudinal movement can be obtained either through a rapid-action lever or through a slower handwheel. The handwheels for both the vertical and cross-feed movements are graduated to thousandths of an inch, the graduations being spaced far enough apart to facilitate finer settings.

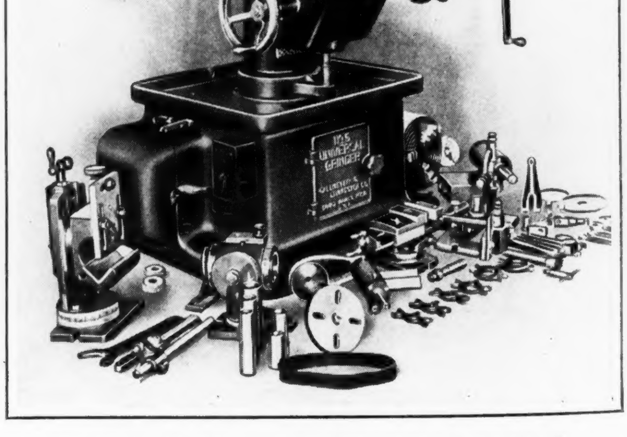
The machine can be made to perform practically every operation in either of two ways; by locking the spindle head in position on the central column the sleeve, knee, etc., can be swiveled around it, and by locking the sleeve in a fixed position, the head can be swiveled. With this construction, the machine can always be set to suit natural daylight or artificial illumination.

Either hand or power longitudinal feed of the table can be furnished. With the power feed, there is a choice of four speeds of approximately 8, 14, 25, and 44 inches per minute, which adapt the machine to a wide range of work. An automatic positive reverse with trip-dogs that can be set to close limits permit the accurate grinding of shoulder work, etc. The gear-box is mounted rigidly on the saddle, and supported by one side and one end.

The casting that carries the grinding spindle can be swiveled over 90 degrees either way, graduations facilitating settings. The casting is locked to the inner column in such a manner that it does not pinch the outer sleeve. The spindle may be equipped with either ball or bronze bearings. In the design of the machine, especial attention has been given to rigidity throughout.

Either wet or dry grinding can be arranged for, and the machine can be furnished for a belt or motor drive. When motor-driven, a 1 1/2-horsepower motor is mounted in the base and belted to the grinding-wheel spindle over two sets of ball-bearing idler pulleys. Two spindle speeds are provided. A 1/4-horsepower motor built into the headstock revolves the work.

Some of the important specifications are as follows: Maximum swing between centers in grinding reamers, 10 1/2 by 42 inches, and in cylindrical grinding, 10 1/2 by 38 inches; longitudinal travel, 32 inches; transverse movement, 10 inches; vertical movement, 10 3/4 inches; dimensions of table, 6 by 50 inches; distance from center line of spindle to table, 10 1/4 inches; and weight of motor-driven machine with standard equipment, 2000 pounds. A chuck larger than the standard and a deep-hole internal attachment can be supplied.



Grand Rapids Heavy-duty Cutter and Tool Grinder

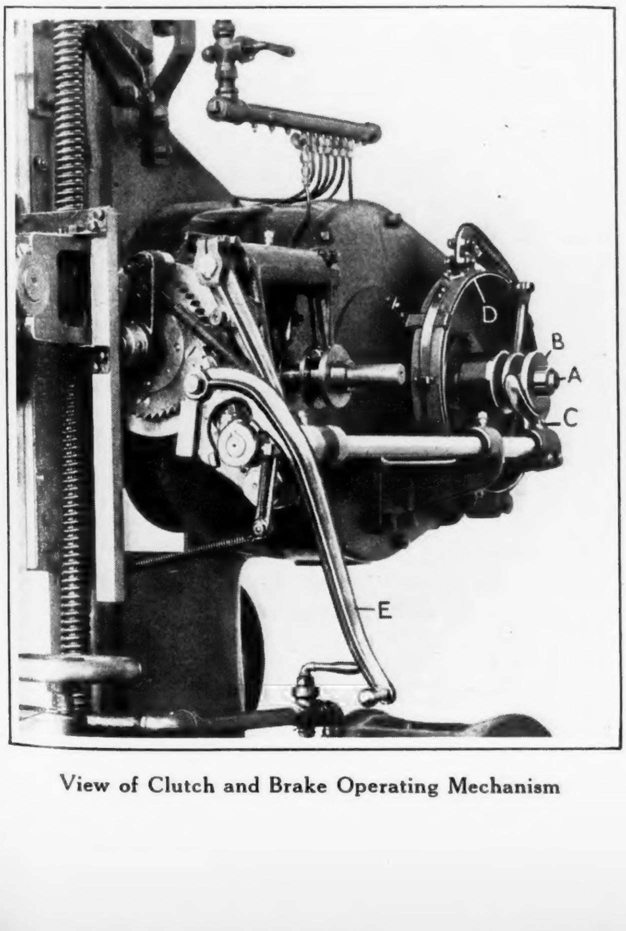
MOLINE AUTOMATIC CYLINDER LAPPING MACHINE

Several improvements have been made in the No. 10 automatic multiple-spindle lapping machine built by the Moline Tool Co., Moline, Ill., since this machine was described in December, 1926, MACHINERY. One of the improvements has resulted in the elimination of two clutches required in the original design. One of these clutches was mounted on the main drive shaft for controlling the rotation of the spindles, while the other was mounted on the main driving gear and controlled the reciprocation of the spindles independently of their rotation.

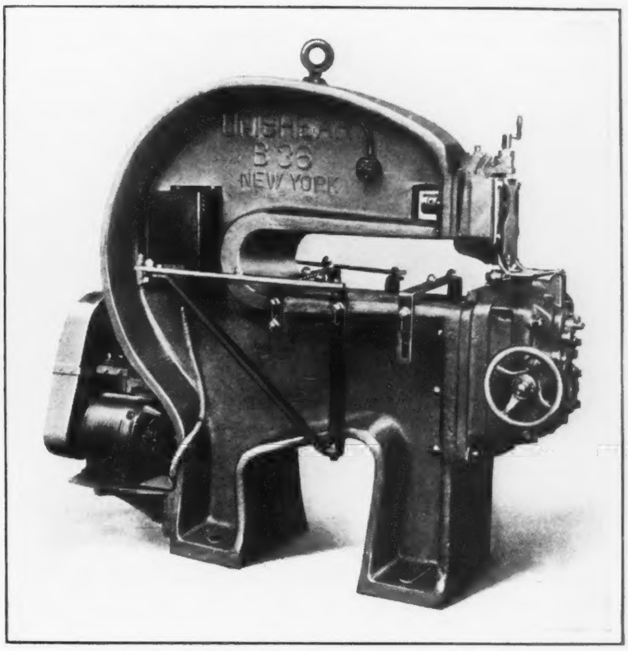
In the improved design of this machine, one large "Twin Disc" clutch has been substituted for the previous clutches. The new clutch is mounted with the drive pulley on the main drive shaft, and through it the entire machine can be started and stopped at will. This clutch is actuated through the center of the main drive shaft by plunger *A*, the plunger being operated by spool *B* and shifter *C*.

A large brake *D* mounted on the end of the main drive shaft is operated by the same parts as the driving clutch. This feature gives a positive and sensitive control of the machine, the brake being applied at all times when the clutch is disengaged. The brake is particularly desirable for stopping the reciprocation of the rail and the rotation of the laps in the withdrawn position. It also eliminates shock in starting the machine.

The operator shifts starting lever *E* to engage the driving clutch and release the brake, simultaneously starting the rotation of the laps and bringing them down into the working position. In this position, they reciprocate a predetermined number of strokes, and then return to the starting position where they instantly stop rotating as well as reciprocating.



View of Clutch and Brake Operating Mechanism



"Unishear" which Cuts Cold-rolled Steel Sheets up to 1/4 Inch Thick

"UNISHEAR" SHEET-CUTTING MACHINE

Cold-rolled steel sheets up to 1/4 inch thick can be cut rapidly in a model B "Unishear" now being introduced to the trade by the Unishear Co., Inc., 170 Fifth Ave., New York City. Straight or curved lines can be followed in cutting plates to various outlines, it being possible to cut curves to a radius as small as 6 inches. Cutting can be performed anywhere on a plate at speeds ranging up to 10 feet per minute. The machine has a throat 36 inches deep and weighs approximately 5000 pounds.

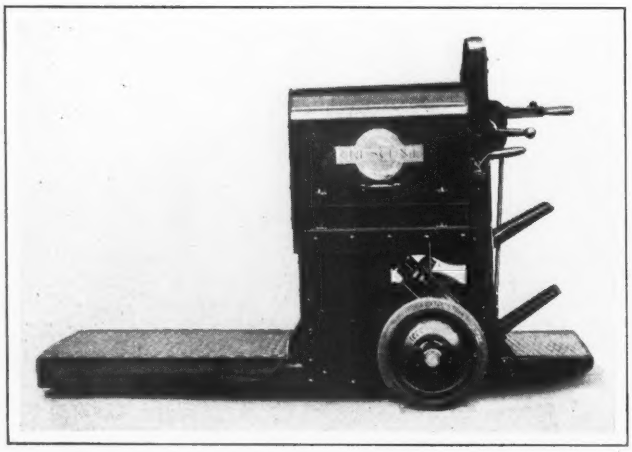
This new machine operates on the same principle as the lighter model 0 "Unishear" described in June, 1926, MACHINERY. There is an upper stationary blade mounted in the head on the forward end of the top frame extension. The movable blade, with its oscillating rocker and driving mechanism, is mounted directly beneath on the front of the frame. Both units are self-contained.

The drive shaft runs beside the center frame rib; it is supported at the rear in a self-aligning ball-bearing pillow block, and is rigidly coupled at its forward end to the main shaft of the lower shear head. All revolving shafts of the shear head are mounted on tapered roller bearings, and all moving parts are lubricated.

Viewed from the front of the machine, the material is fed from right to left. Ball-bearing casters mounted on swinging arms and brackets support heavy sheets and facilitate their movement. The arms and brackets are adjustable vertically. Where the shearing takes place, the sheet is supported by the table and adjacent rollers. The latter are adjustable for height by means of a handwheel to take care of different thicknesses of sheets.

CRESCENT LIGHT-WEIGHT ELECTRIC TRUCK

An electric truck having a capacity for hauling loads up to approximately 2500 pounds, with an over-all length of only 82 inches and an over-all width of 30 inches, has been brought out by the



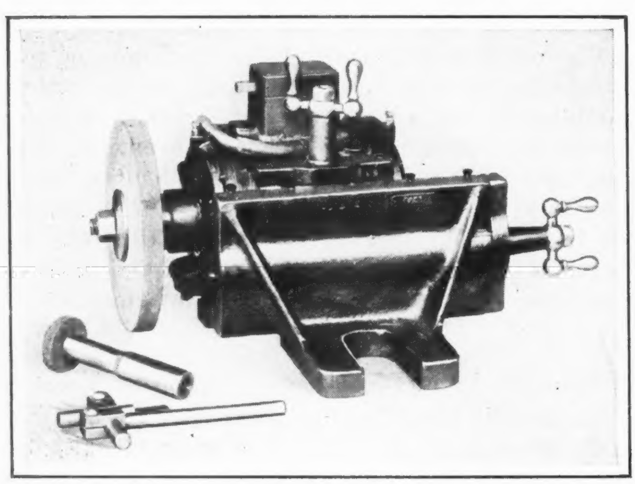
Crescent Truck for Loads up to About 2500 Pounds

Crescent Truck Co., Lebanon, Pa. Owing to the short length, narrow width, and light weight, this "Crescent Star" truck may be run on small elevators and conveniently operated through 32-inch doorways. It has been developed mainly for use with 7-inch hand-lift truck skids. The speed of the unloaded truck is 6 miles per hour and of the loaded truck, from 4 to 5 miles per hour. The minimum turning radius is 7 feet 6 inches and the weight, with a nine-plate battery, approximately 1525 pounds.

GRINDING ATTACHMENT FOR VARIOUS MACHINE TOOLS

General grinding operations can be performed on lathes, milling machines, planers, and similar machine tools by means of a motor-driven grinding attachment recently developed by the Standard Electrical Tool Co., 1936 W. Eighth St., Cincinnati, Ohio. This grinder is arranged with a vertical and a horizontal feed, as illustrated. It is built in three sizes: the 1/2-horsepower size carries an 8- by 1-inch wheel; the 1-horsepower size, a 10- by 1-inch wheel; and the 2-horsepower size, a 14- by 1 1/2-inch wheel.

The horizontal bracket of this attachment can be made any desired length. The bearings are made of phosphor-bronze and are of the split taper adjustable type. Adjustments are made by means of lock-nuts located under the grinding wheel flanges. This equipment is especially adapted to grinding collector rings of large generators.

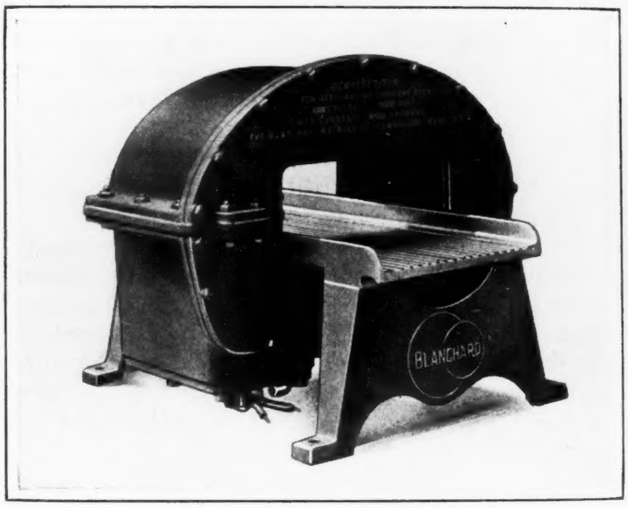


Grinding Attachment with Horizontal and Vertical Feeds

BLANCHARD DEMAGNETIZER

A demagnetizer for removing residual magnetism from small pieces such as hardened washers, rings, cutter teeth, tool bits, reamer blades, etc., that have been held on a magnetic chuck has recently been added to the products of the Blanchard Machine Co., 64 State St., Cambridge, Mass. This appliance is of the coil type, and is intended for use with alternating current only. It will handle quantities of small pieces at a rapid rate, but is not recommended for single heavy pieces, although the opening will pass a piece 6 1/2 inches wide by 2 7/8 inches high.

The coil is designed for maximum effect consistent with safe temperature when operating continuously. It is thoroughly insulated, and is entirely enclosed in a brass case, which protects the coil and connections from mechanical injury or dampness. The terminals are brought out on the under side in a fitting to take a 1/2-inch flexible conduit. The coil is wound for the current on which it is to operate, and cannot be used on any other. Coils are stocked for 60-cycle current of 110, 220, 440, and 550 volts, but other coils can be furnished if desired.



Blanchard Demagnetizer for Alternating Current

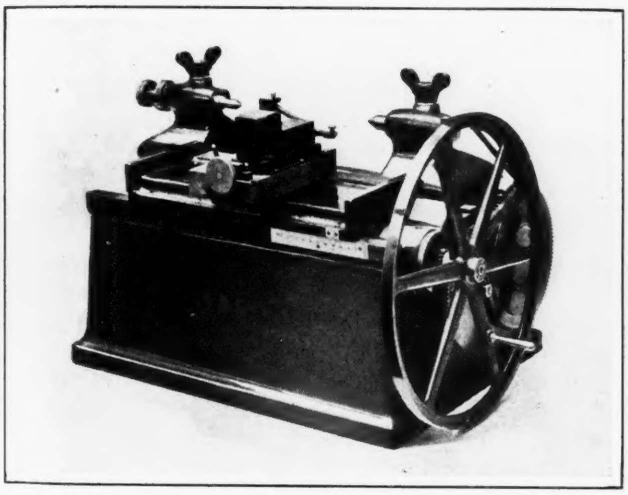
In using the demagnetizer, pieces are simply placed on the shelf and slid slowly through the coil. Groups of pieces can be pushed ahead as fast as more pieces are added, letting the pieces that have passed through, fall off the far end of the shelf. If pieces of medium or large size are not thoroughly demagnetized, they should be turned around as they pass slowly through the coil or passed through more than once in different positions.

SCREW-THREAD PITCH MEASURING MACHINE

An apparatus for measuring the pitch of screw threads has recently been brought out by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, and is being sold in the United States and Canada by the R. Y. Ferner Co., Investment Bldg., Washington, D. C. This machine is adapted for measuring both internal and external threads. It will hold plug gages up to 6 inches in diameter and 8 inches in length.

The bed of the machine has ways on which are mounted two stocks carrying adjustable centers for the support of gages on which external threads are to be tested. A micrometer slide on separate ways is moved parallel to the axis of the gage, by rotating an accurate screw. The travel of this screw is 4 inches. It has ten threads per inch (or a pitch of 2 millimeters, in metric instruments). A large drum mounted on the screw is graduated to 0.00005 inch. An auxiliary scale with an index, graduated to tenths of an inch, permits reading the larger units of measurements.

The micrometer slide actuated by the lead-screw carries an amplifier in which various measuring anvils may be mounted. As the slide is advanced along its ways, the measuring anvil moves up and down over the flanks of each thread along a line parallel to the gage axis. An adjustment is provided for the amplifier, so that its indicator may be made to read zero at any desired point on the flank of a thread, that is, at any fixed distance from the axis of the gage. By taking readings on the micrometer head at the first setting on any



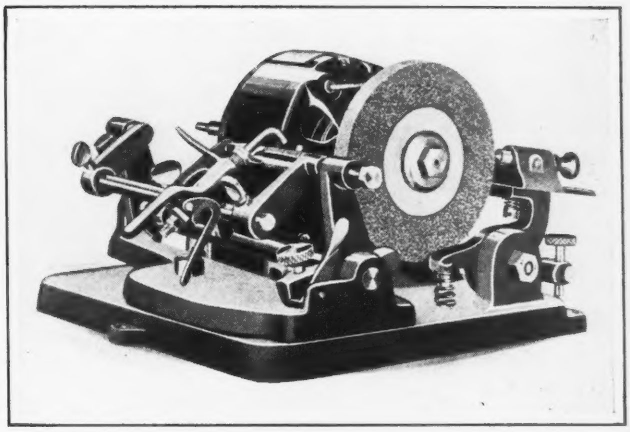
Societe Genevoise Thread Measuring Machine

initial thread selected, and then taking readings at the same position of the measuring anvil on the flanks of other threads, the observer actually takes successive readings for the positions of the thread gage on the successive thread flanks. The differences of the successive readings will be the actual pitch. A knife-edge multiplication system gives a sensitivity of 0.00001 inch.

For measuring the pitch of internal threads, the tailstock at the left-hand end of the machine is removed and a support substituted on which there is a faceplate for mounting the thread gage to be tested. Another anvil is substituted on the amplifier device, this anvil being mounted on an arm which can be extended inside of the ring gage to pass over the flanks of the threads in the same manner as in making external thread measurements. The measurements are carried out in the same way as before, except that the micrometer slide is moved in the reverse direction.

WELLS TAP AND REAMER SHARPENERS

Two machines designed for grinding or sharpening taps and reamers have recently been developed by the Wells Mfg. Co., P. O. Box 613, Greenfield, Mass. The illustration shows the tap sharpener, the reamer sharpener being quite similar in appearance. Taps are ground eccentrically, with the cutting points the shape of a well designed lathe tool. Taps up to 3/4 inch can be accommodated.



Wells Tap Sharpener or Grinder

Relief is ground eccentrically on reamers and to a true curve. Reamers from 1/2 to 1 inch can be ground. Both of these machines may receive current from an electric light socket, being equipped with a self-contained motor drive.

IMPROVEMENTS IN NILES AXLE LATHE

Two new features have recently been incorporated in the No. 3 double axle lathe built by the Niles Tool Works Co. Division of the Niles-Bement-Pond Co., 111 Broadway, New York City. These features add to the convenience and productive capacity of the machine. One feature consists of the equalizing driving head shown in Fig. 1, which may be furnished in place of the regular driving plate and driver dog. The second feature is a multiple tool-holder. Either or both are offered as optional to the standard equipment.

The new driving head consists of a driving spool upon which is mounted an internal gear ring. Equally spaced pin-holes are drilled radially in the outside of this ring. There are three driving dogs having serrated inner ends that contact with the axle, and gear segments are cut on their outer ends to mesh with the internal gear ring. Each dog swings on a pivot, and is held in engagement with

Fig. 1. Niles Axle Lathe Equipped with Equalizing Driving Head

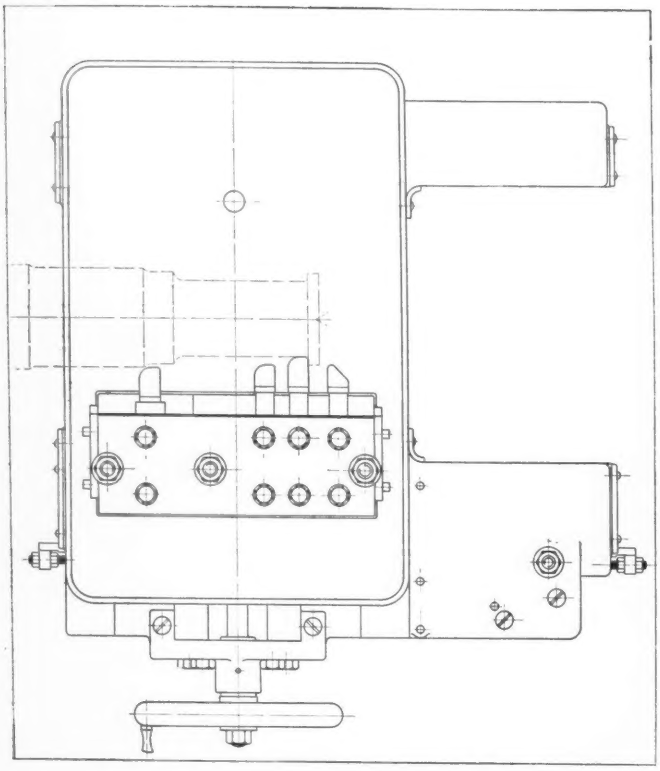


Fig. 2. Manner of Using Multiple Tool-holder

the axle by means of springs. However, when a dog once comes in contact with the axle and the machine is started up, the pressure of the cut increases the grip of the dog and prevents any slip.

An equalizing feature takes care of any eccentricity or roughness in the axle forging without distorting the axle. Another advantage is that each dog takes its equal share of the load. To release the dogs, a pinch bar is inserted into one of the radial pin-holes and the gear ring given a partial turn. The jaws are held open for removing or inserting axles. Axles up to the full capacity of the machine may be driven by means of this driver with one set of jaws, there being a considerable rotary movement of the gear ring.

Fig. 2 shows diagrammatically how the multiple tool-holder is used. This tool-holder carries four tools which may be spaced and shaped to perform specific operations on the collar, journal, dust guard and wheel seat of an axle, with minimum movement of the carriage. Means are provided for locating the tools properly, so that they may be withdrawn for sharpening and reinserted without destroying their positions relative to one another.

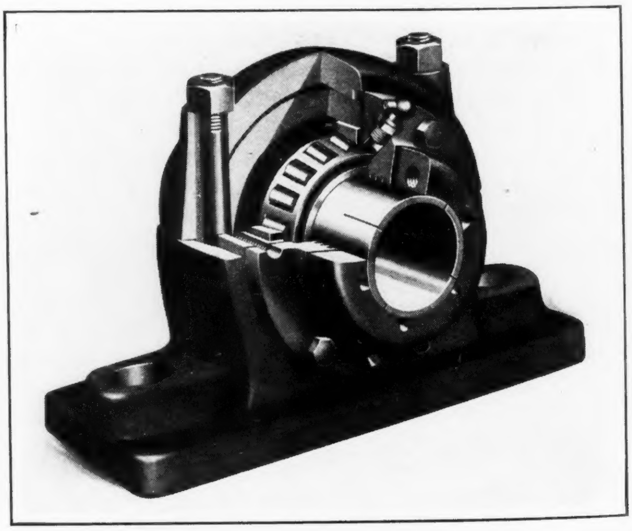
MEDART TIMKEN-BEARING TRANSMISSION EQUIPMENT

Timken tapered roller bearings are provided in a line of spherical ball and socket pillow blocks, ball and socket hanger bearings, unit mountings, and loose pulleys now being placed on the market by the Medart Co., St. Louis, Mo., for many industrial applications. Features claimed for these appliances are that power and lubricant are saved, alignment preserved, and wear practically eliminated. The unit mounting is adapted to suit the needs of various machine designs, mountings being made with different types of housings. The loose pulley may be used on lineshafts and countershafts.

The Medart Timken-equipped unit comprises two tapered roller bearings, assembled on a sleeve of ground steel tubing and fitted into a finished cast-iron hub. The hub is machined to fit into a suitable housing adapted for use either in a spherical ball and socket pillow block, a unit mounting for duplicate machinery, or a loose pulley. The assembled sleeve without the hub is mounted in an hour-glass type of housing to form the ball and socket hanger bearing. The steel sleeve is slotted at each end, and is held tight on the shaft by steel clamping collars at each end of the sleeve.

In installing a pillow block, the sleeve must not be clamped to the shaft until the hub or unit containing the roller bearings has been aligned carefully with the center of the housing, and the cap of the housing has been securely bolted down. Lubricant is forced into the races of the roller bearings through Alemite or Zerk fittings. Grease seals are placed in the flanges at the ends of the bearings to prevent dust from entering or lubricant from leaking out. The large ends of the rolls point inward or toward the center of the bearings, which insures that the lubricant will be pumped away from the end enclosures instead of toward them.

Particular attention is called to the fact that each entire bearing arrangement is positive and tamper-proof, due to take-up being provided for by bearing cups or outer races and by a cap and shim method. Roller bearings remain in their original position, regardless of how much the appliance may be handled in delivery to the user or how many times it may be removed and replaced on a shaft. The roller bearing cups or outer races are metal-to-metal fits in the housings. The grease seal is obtained by means of annular grooves in the end bores of each box and close fits to shafts or sleeves. The clamping collars and sleeve are of simple construction, so that it is possible to quickly replace these parts in small machine shops when necessary, without having to await the delivery of repair parts from the manufacturer. Sleeve and cone assemblies mounted in one unit can be applied to or removed from the box without taking the bearing cones from the sleeve. The outer races or cups of bearings are also easily removed from the box.

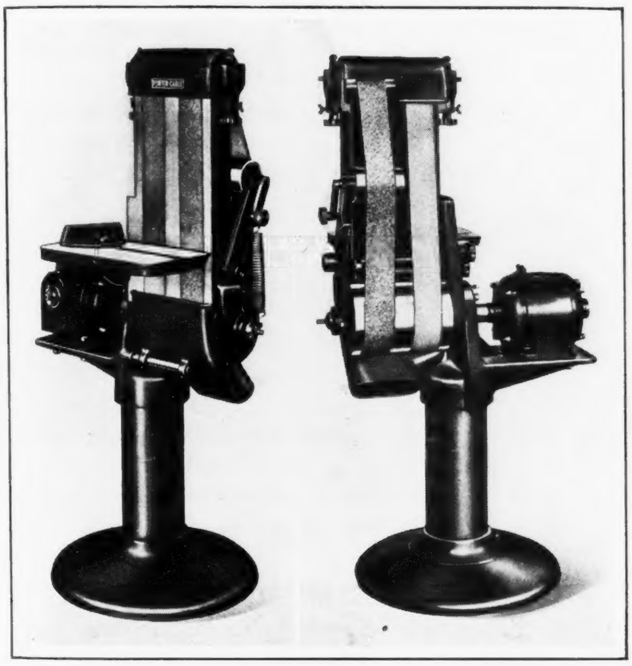


Medart Pillow Block with Tapered Roller Bearings

SYRACUSE TWO-BELT SANDER AND GRINDER

An attachment recently developed by the Porter-Cable Machine Co., N. Salina and Exchange Sts., Syracuse, N. Y., for use on the Syracuse type B-3 belt sander and grinder makes it possible to use two belts, each having a maximum width of 4 1/2 inches. This machine ordinarily carries a single belt 10 inches wide. With two belts, one may be used for roughing work and the other for finishing it.

The attachment consists of an aluminum idler pulley held against the right-hand belt by means of a spring, which automatically gives the proper tension. If, by chance, this spring should break, an adjustable stop on the idler pulley arm prevents the arm and pulley from swinging downward and damaging itself or the machine. Curved or irregular shapes can be sanded at the back of the machine, which is shown at the right, due to the belt flexibility obtained with the third pulley. When it is desirable to use the front of the machine and flexibility is also necessary, a flexible canvas and felt pad can be fastened to the metal bed to provide a resilient backing under the belt.

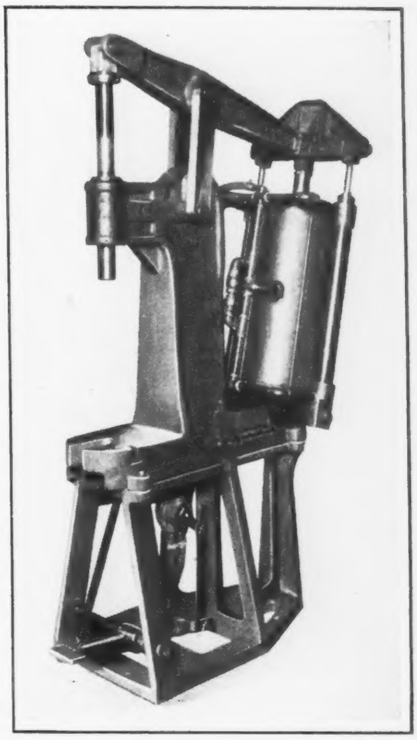


Syracuse Sander with Two-belt Attachment

The lower drive pulley is straight, while the top pulley is double crowned for each belt. The belt on the motor side of the machine is tracked by using two knobs at the top of the machine, while the other belt is tracked through a single knob on the third pulley arm. The attachment is designed for use in machine and woodworking shops.

HANNIFIN AIR-OPERATED ARBOR PRESS

Air-operated arbor presses built by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., may now be equipped with oil cylinders which provide a cushioning effect at the end of the ram stroke in broaching and similar operations. On the standard arbor presses made by this concern, the load or resistance decreases, and consequently the broaching speed increases, as the broach completes its work. Hence, the speed of the ram is not uniform, and this is an impractical condition. The two oil cylinders provide the desired uniform ram movement.

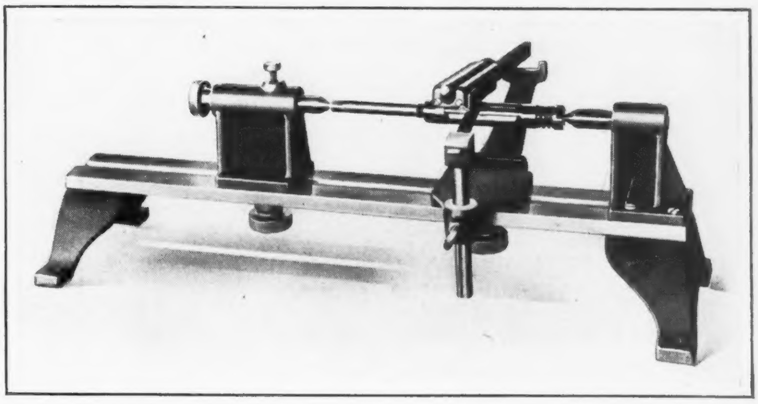


Air-operated Arbor Press with Oil Cushioning Cylinders

As may be seen from the illustration, one of the oil cylinders is mounted on each side of the air cylinder. The oil-cylinder piston-rods are fastened at the upper end to a connecting link. On the downward stroke of the press ram, which corresponds to the upward stroke of the air piston, oil is forced from one end of the oil cylinders to the other end, passing through a restricting valve the opening of which can be set to provide any desired speed of travel. On the return stroke of the ram, the speed is not restricted, because a by-pass equipped with a check valve allows free return of the oil.

FOSTER-JOHNSON IMPROVED REAMER SHARPENER

Straight-bladed reamers, both solid and expansion types, may be conveniently sharpened in a redesigned bench machine now being introduced to the trade by the Foster-Johnson Reamer Co., Elkhart, Ind. This equipment is intended for use with reamers up to 16 inches in length and 5 inches in diameter, having centered ends. One of the features of the machine is that the spring tooth which



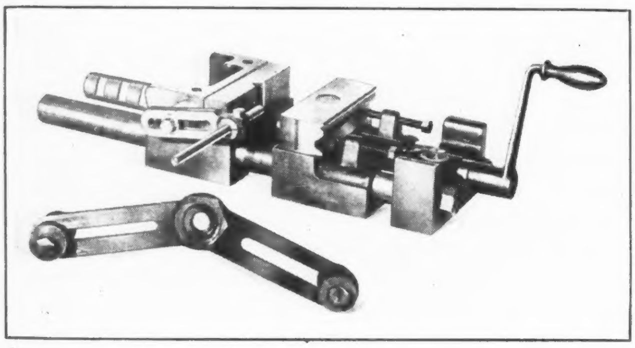
Foster-Johnson Machine for Sharpening Solid and Expansion Reamers

supports the reamer blades while they are being sharpened, and the rest which guides the hone, are both adjustable to suit any clearance angle.

For a sharpening operation, the reamer is mounted between the centers of the headstock and tailstock as shown. Then the user grasps the hone handle with the right hand and holds the reamer blade firmly against the spring tooth by means of the left hand. While exerting a slight pressure on the hone, the latter is drawn back and forth over the top of the reamer blade. When it is desired to hone the next blade, the reamer is indexed with the left hand to bring the blade against the spring tooth. It is considered best practice to take a few strokes at a time on each blade, continually indexing the reamer until it has been completely sharpened. About the same number of strokes should be made on all blades.

UNIVERSAL DRILLING MACHINE VISE

A No. 6 universal vise designed to hold various sizes and shapes of work and intended primarily for use on drilling machines has been added to the line of products of Miller & Crowningshield, Greenfield, Mass. The rear block of this vise can be quickly moved along the bars to any position and locked in place by slipping a key into the slots in the bars. A screw is used for quickly clamping and unclamping the work.



Drilling Machine Vise Made by Miller & Crowningshield

Lugs provide for clamping the vise to a drilling machine table when the vise is turned up on edge for drilling the end of a long bar or for holding any work that cannot be held otherwise. The guide bushing holder shown below the vise in the illustration can be mounted on top of the vise and adjusted to a convenient position for drilling a hole in the same place in duplicate parts. It may be locked in any position within 3 inches of the jaw faces. Quick-change slip bushings may be furnished for various sizes of holes. Special vises with bars of any length can also be furnished. Both steel jaws may be used with either side up to bring the V-grooves on the front or back of the jaws. The weight of the vise is 60 pounds.

TRENT BABBITT MELTING POT

A special electrically heated babbitt melting pot, which has a capacity for 750 pounds of metal, was recently made by the Harold E. Trent Co., 439-43 N. Twelfth St., Philadelphia, Pa. The pot is shown in the illustration complete with a pouring spout, tilting mechanism, and automatic temperature control.

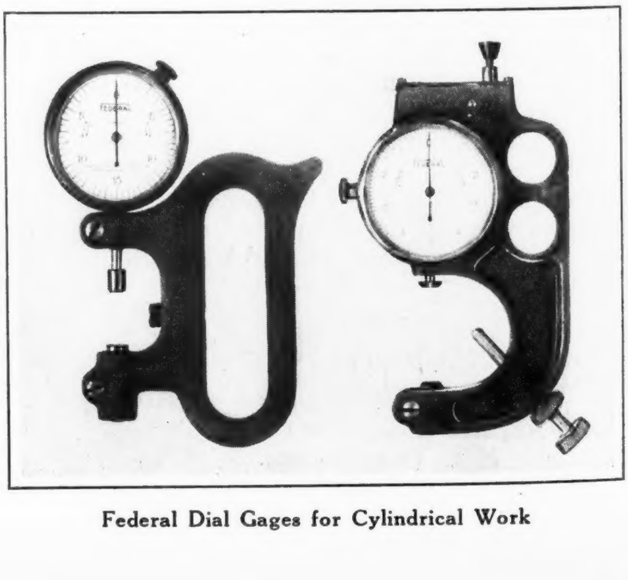
Trent Electric Melting Pot for Babbitt

The design follows closely that of standard Trent melting pots, having a cast-iron crucible, steel case, heavy insulation, etc. One of the features of this pot is the application of a temperature control that functions no matter what the position of the pot. The constant use of the temperature control insures correct heating of the babbitt, right up to the time that it is poured into bearings.

The tilting mechanism is operated by means of a handwheel conveniently placed. Special attention has been given to the construction of the worm-gear drive which makes the pot easy to tilt and yet is positive in action.

FEDERAL DIAL GAGES

Two dial gages intended for measuring cylindrical parts have recently been added to the line of precision measuring instruments manufactured by the Federal Products Corporation, Providence, R. I. These gages were originally designed for measuring the diameters of camshafts and crankshafts, but they are also useful for measuring wrist-pins, bushings, and other cylindrical pieces. The gages are of watch-type construction.

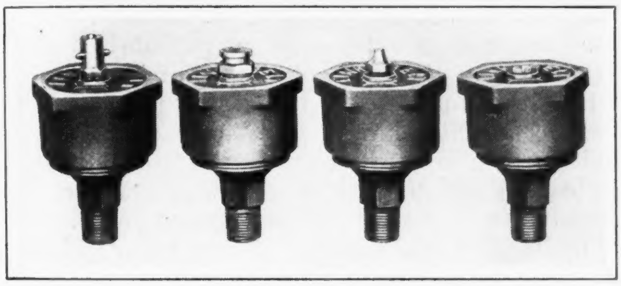


Federal Dial Gages for Cylindrical Work

Several different types of indicators can be furnished on the new gages, including the model 30, shown on the instrument at the right, which is graduated to 0.0001 inch. The jaws of these gages may be made to take any diameter of stock up to 2 inches. Adjustable lower anvils are supplied when the gages are to be used for measuring a variety of sizes greater than the range of the indicator.

GREASE CUPS WITH ALEMITE FITTINGS

"Hex-Top" malleable-iron compression grease cups provided with Alemite or Zerk fittings are being manufactured by the Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill. The tops of these cups are six-sided and offer an easy purchase for any type of wrench or a good grip for the hand. The combination of a compression grease cup and an Alemite fitting is particularly advantageous in such installations as long belt conveyors requiring many grease cups for the idlers. In such an installation, it is an easy matter to fill all the cups at one time by employing a grease gun. If a bearing should get warm when the grease gun is not at hand, a turn or so of the cup would take care of the emergency. Another advantage is that cups located in inaccessible places may be readily filled.



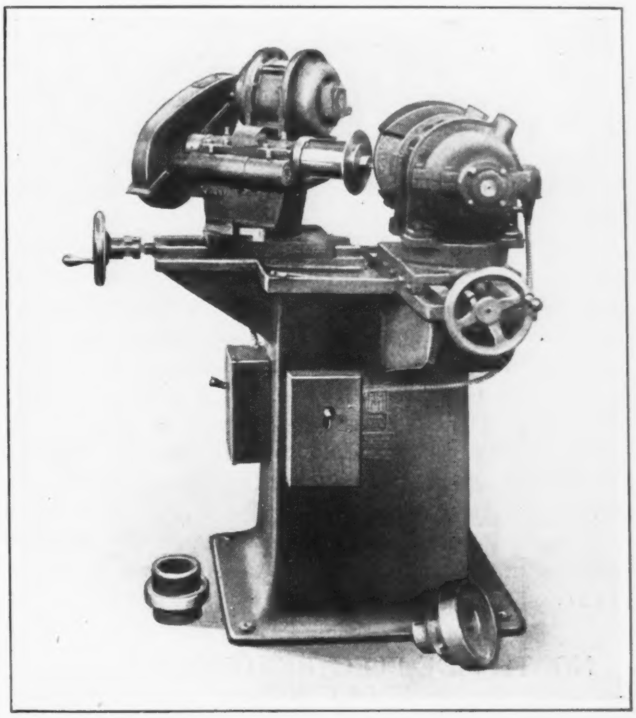
Grease Cups Provided with Alemite and Zerk Fittings

BRIDGEPORT SLITTER AND DISK GRINDER

A motor-driven slitter and disk grinder has recently been introduced to the trade by the Bridgeport Safety Emery Wheel Co., Inc., 1283 W. Broad St., Bridgeport, Conn. The illustration shows this machine arranged for grinding slitter cutters while held on the work-spindle by a nut and suitable bushings that compensate for various sizes of holes in the cutters. The machine is arranged for an alternating-current motor drive, all belting being eliminated. A magnetic chuck, universal chuck, expanding mandrel, and faceplate may also be used for holding the work.

The grinding wheel is carried directly on the shaft of the driving motor, and is provided with a suitable guard. The motor shaft is equipped with ball bearings, there being one bearing in each motor and shield. These bearing take all radial load and stabilize the shaft endwise, resulting in a free and smooth-running grinding wheel. The wheel-head may be swiveled on its slide, the slide being operated in and out by revolving a handwheel.

The work-spindle is driven by a motor mounted directly on the work-head and connected to the spindle by a silent chain and gearing which gives the proper work speed. The work-head is mounted on a slide upon which it may be swiveled. The swivel arrangement permits of grinding bevels either way on work. This slide may also be fed in or out by revolving a handwheel. A graduated collar indicates the amount of feed. The ways on which the work-head slide moves are at right angles to those of the grinding head.

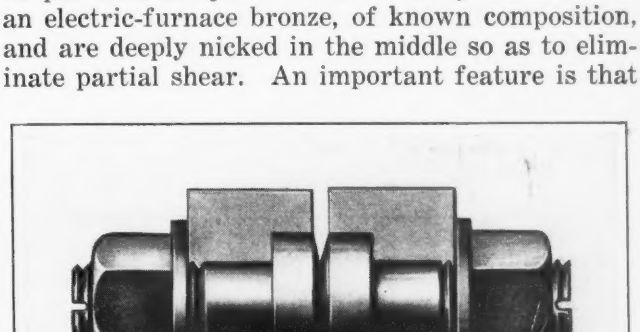


Bridgeport Motor-driven Slitter and Disk Grinder

The machine is arranged for grinding dry, but it may be equipped for wet grinding, using a centrifugal pump. The grinding wheel is 10 inches in diameter, 5/8 inch thick, and has a 1-inch hole. The machine has a maximum swing of 16 inches, and weighs approximately 1250 pounds.

BROWN COUPLING SHEAR PINS

Shear pins of a new design are provided in the shear pin couplings now being manufactured by the Brown Engineering Co., 133 N. Third St., Reading, Pa. These pins are made to shear within 10 per cent of specified loads. They are made of an electric-furnace bronze, of known composition, and are deeply nicked in the middle so as to eliminate partial shear. An important feature is that



Construction of Shear Pin Used in Brown Couplings

the two flanges connected by the pins are held apart a definite amount.

Each pin has collars large enough to obtain sufficient bearing in the two flanges, and these collars separate the flanges. When pins break, the coupling casing, or one of the flanges, is free to slip axially, giving the broken ends freedom to pass each other. However, the ends cannot fly loose.

For easy replacement, the flanges are slotted to the body size of the pins, and are countersunk to receive the collars. To remove broken pins, the nuts are taken off and the coupling or flange slipped along the shaft sufficiently to release the pin collars from their recesses. A gear or similar part may be held by a set-screw in a shallow circular groove to prevent it from moving too far when pins shear. By slackening the set-screw, the gear can be moved to replace the pins. These shear pins are made in standard sizes, and any number may be used to obtain the desired resistance to shear.

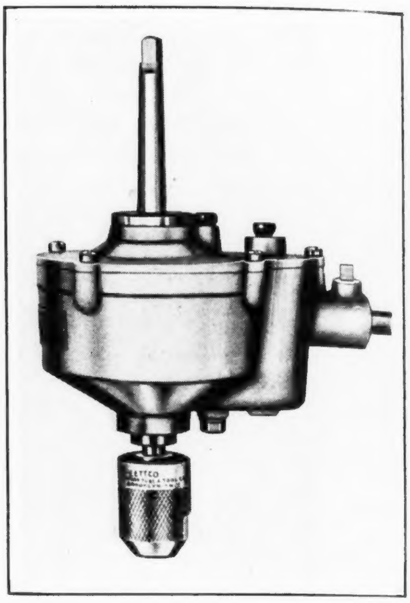
NORTH SIDE ELECTRIC GRINDERS AND BUFFERS

Bench and pedestal types of motor-driven grinders and buffers are being introduced on the market in 1/4-, 1/2-, and 3/4-horsepower sizes by the North Side Tool Co., 17-19 Maryland Ave., Dayton, Ohio. They are furnished for speeds of 1750 or 3450 revolutions per minute. Single-phase alternating-current motors of the repulsion induction type are provided, and they may receive current from any convenient lamp socket. Air ducts in the motor frames allow free circulation of air for cooling the motors. Adjustable guards and tool-rests are provided for grinding wheels. Combination grinders and buffers are obtained by mounting a grinding wheel on one side of a motor and a buffing wheel on the opposite side.

Pedestal-type Motor-driven Grinder

"ETTCO" HIGH-SPEED TAPPING ATTACHMENT

Taps up to 3/8 inch are handled by the No. 2 "Ettco" tapping attachment recently brought out by the Eastern Tube & Tool Co., Inc., 590 Johnson Ave., Brooklyn, N.Y. This device follows closely the design of the attachment described in June, 1922, MACHINERY, which receives taps up to 1/4 inch in diameter. Both sizes are designed for high-speed sensitive tapping.



"Ettco" Tapping Attachment for Taps up to 3/8 Inch

A leather-lined cone clutch and cast-iron driving cone give a smoothness of action and a slipping point which prevent the breakage of taps. It is claimed that an inexperienced operator can hit the bottom of a tapped hole without breaking the tap. The operator can stop or enter a tap at any desired speed, regardless of the speed of the drilling machine on which the tap is used, by simply regulating the drilling machine lever. If a tap sticks or hits the bottom of a hole, the clutch slips, and if it sticks in backing out, the reverse cone slips. The reverse speed is twice as fast as the forward speed.

By locking the threaded Morse taper shank in the tapper, left-hand threads can be tapped as readily as right-hand. An aluminum case and light alloy steel parts greatly reduce the weight of this device.

HISEY COMBINATION GRINDING AND BUFFING MACHINES

Bench and floor-stand models of motor-driven combination grinding and buffing machines recently brought out by the Hisey-Wolf Machine Co., Cincinnati, Ohio, are here illustrated. These machines are built in one- and two-horsepower sizes. Fig. 1 shows the bench machine equipped with an open-type spindle extension, which is most practical for close-corner work, while Fig. 2 shows the

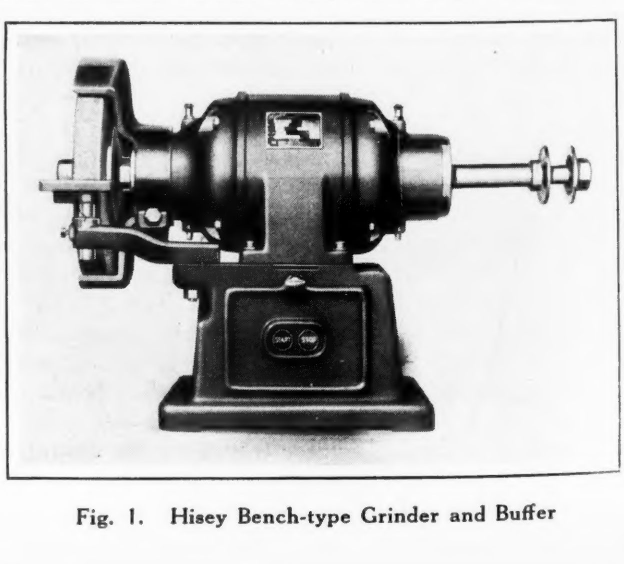


Fig. 1. Hisey Bench-type Grinder and Buffer

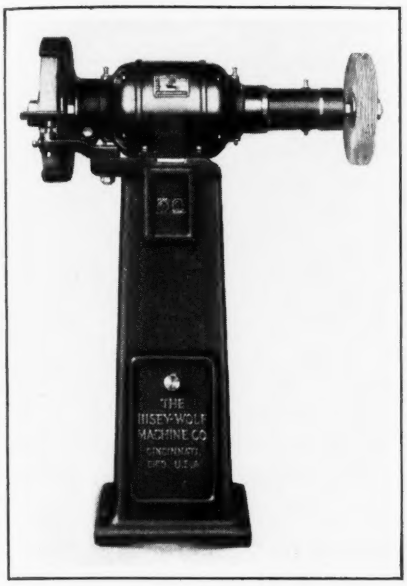


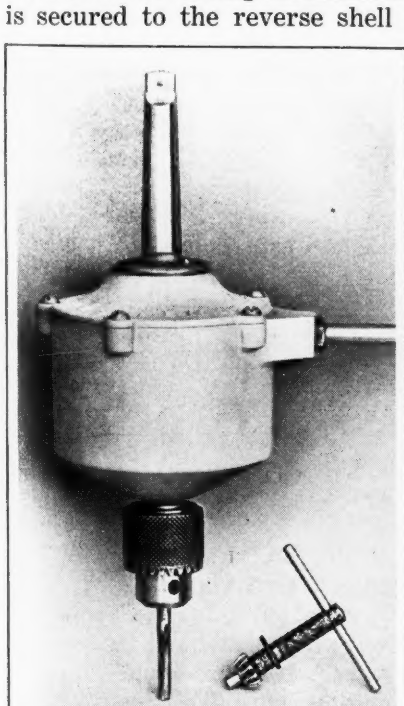
Fig. 2. Floor-stand Grinding and Buffing Machine

floor-stand machine equipped with an encased-type spindle extension. This extension is provided with ball bearings, and is intended for heavy-duty buffing, polishing, and scratch-brush work.

Single-phase alternating-current machines are equipped with improved commutating-type repulsion induction motor, while two-phase and three-phase alternating-current machines are equipped with squirrel-cage motors. A motor starter with push-button control is provided.

PROCUNIER HIGH-SPEED TAPPING ATTACHMENT

Taps up to 1/4 inch may be driven into steel and taps up to 5/16 inch into cast iron or brass with a new high-speed tapping attachment recently developed by William L. Procunier, 18 S. Clinton St., Chicago, Ill. The mechanism of this attachment is contained in an aluminum housing. A Morse taper shank is provided which is threaded to fit into a drive shell. The shell is also threaded in the lower end to receive an internal gear which meshes with three intermediate spur gears. The latter are held in position by three equally spaced shoulder studs and engage a reverse gear, thus producing a balanced reversing mechanism. The reverse gear is secured to the reverse shell by means of four pins. The chuck is screwed on the spindle, and the spindle, in turn, is secured to a fiber cone clutch by means of a drive pin which is held in position by a lock-pin. The upper and lower thrusts are taken by ball bearings.



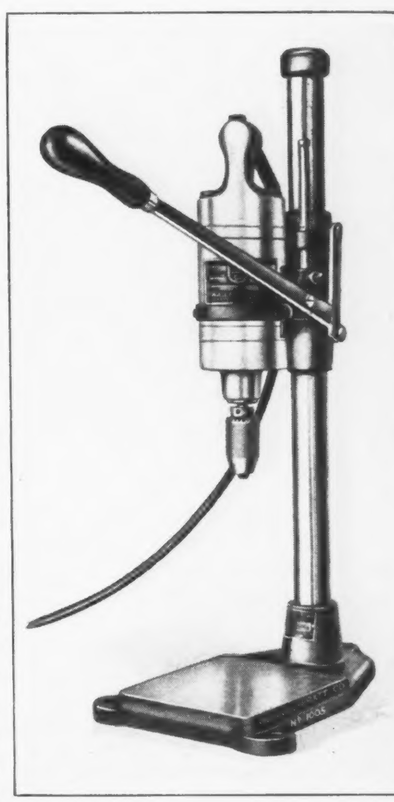
Procunier Tapping Attachment

When tapping, the surface of the upper half of the fiber cone clutch is engaged with the conical surface of the drive shell. The thrust is taken direct on the drilling machine spindle when driving the tap forward. For reversing the tap, the drilling machine spindle is raised about 1/32 inch. This disengages the upper half of the fiber cone clutch from the drive shell and engages the lower half with the conical surface of the reverse shell, which rotates in the opposite direction at twice the tapping speed. Pressure is applied on the gears only when reversing the tap.

Bottom or blind tapping may be accomplished as easily as through tapping, since the power may be regulated by the amount of pressure applied on the machine spindle by the operator.

GOODELL-PRATT DRILL STAND

A stand designed especially for the No. 1042 1/4-inch heavy-duty drill manufactured by the Goodell-Pratt Co., Greenfield, Mass., has been brought out by this concern. The drill is easily slipped into position on the stand, and quickly locked in place by turning a thumb-screw. Neatness of design is a particular feature of the stand, the spring which compensates for the weight of the drill and carriage being located inside the vertical column.

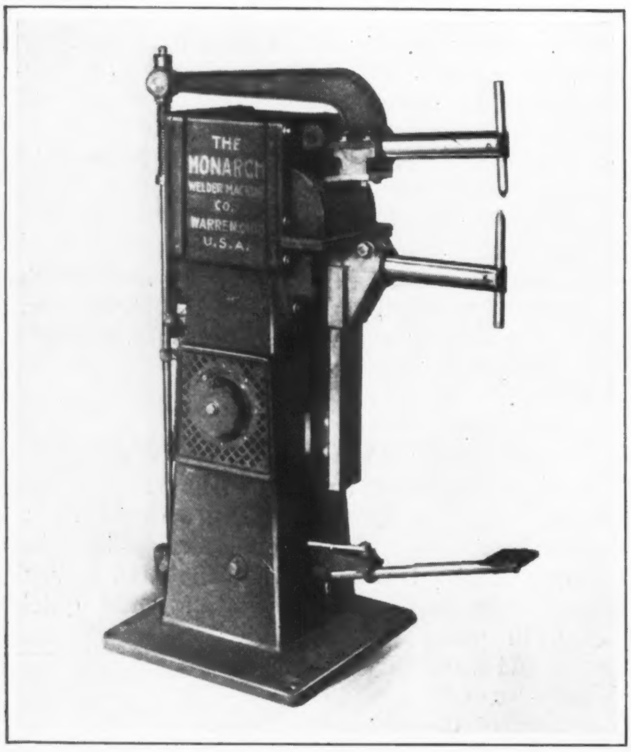


Stand for Electric Drill

The lever feed of this stand can be set to any depth up to 3 1/8 inches. The over-all height is 25 inches, and the diameter of the upright column, 1 1/2 inches. The finished portion of the table measures 6 by 7 inches, while the bench space required is 8 1/2 by 12 inches. There is a maximum distance of 11 3/4 inches between the chuck and the table, and it is possible to drill to the center of a 9-inch circle. The stand, without the drill, weighs 18 3/4 pounds.

MONARCH ELECTRIC SPOT WELDER

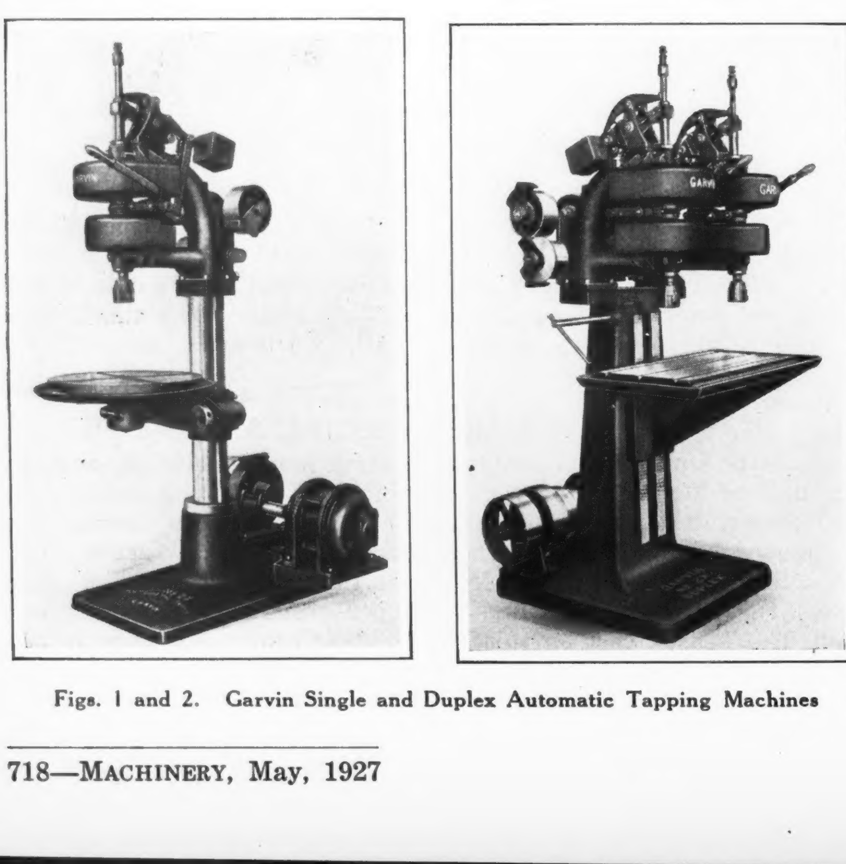
Simplicity of construction is one of the features claimed for the "Little Giant" spot welder here illustrated, which has recently been produced by the Monarch-Welder Machine Co., Warren, Ohio. The main frame of this machine is a one-piece casting, and the upper arm fulcrums on two lugs cast on this frame. The lower conductor is held in a bracket which may be placed in various vertical positions to suit different operations.



Monarch Electric Spot Welder

An automatic switch is located on the back of the machine. By exerting a slight pressure on the foot-treadle, the work is firmly clamped, and an additional pressure closes the switch for welding the parts. Further pressure on the treadle causes the switch to open, but pressure is maintained on the welding points until the weld has set. Material from No. 30 to No. 11 gage can be welded without resetting the switch. The welding points can be held in angular positions as well as vertically.

Both the upper and lower conductors are made of 2-inch round hard-drawn copper. The transformer capacity is 8 kilovolt-amperes. This machine can be supplied with or without water-cooled welding points. It weighs approximately 315 pounds.



Figs. 1 and 2. Garvin Single and Duplex Automatic Tapping Machines

GARVIN AUTOMATIC TAPPING MACHINES

Garvin No. 2-X automatic tapping machines are now built by the Western Machine Tool Works, Holland, Mich., with the head and column as separate units, as illustrated in Fig. 1. All machines of this line are equipped with Timken tapered roller bearings.

The duplex machine, shown in Fig. 2, is provided with a new column of heavy box section, in which is housed a counterweight for the table. This counterweight is connected to the table by a chain running over a sprocket wheel. To adjust the position of the table, it is merely necessary to release the table clamp and turn a handle connected to the sprocket wheel. A hand or foot control can be provided for the spindles. Automatic action of this machine is provided, as on other Garvin tapping machines.

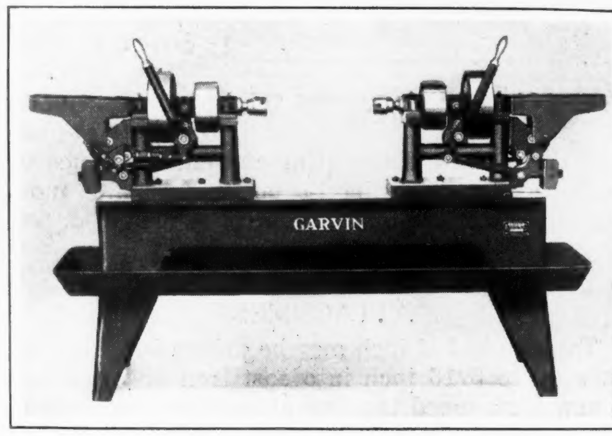
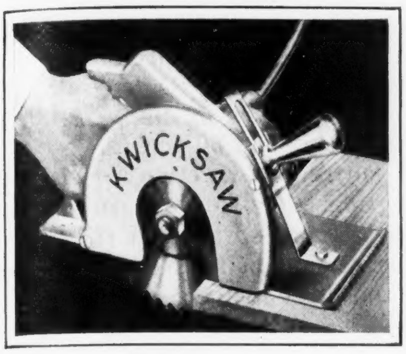


Fig. 3. Horizontal Duplex Tapping Machine

The horizontal duplex machine illustrated in Fig. 3 has been designed primarily for production use in automotive, electric, pipe-manufacturing, and other industries. It may be used on small or large work which requires tapped holes in both sides or ends, and these holes can be tapped in one operation. The two heads are movable along the bed, and either one can be quickly removed. Both of the heads may be fed toward the right or toward the left. Jigs or fixtures can be fastened to the bed between the spindles. The friction clutches are operated mechanically.

PORTER-CABLE "KWICK-SAW"

An electrically driven hand saw designed to save hours of labor in pattern shops and shipping rooms has recently been produced by the Porter-Cable Machine Co., N. Salina and Exchange Sts., Syracuse, N. Y. This device takes its name from the high speed at which the saw is revolved. It leaves a smooth edge, which often makes planing unnecessary. The saw is mounted directly on a special motor arma-



Porter-Cable Electrically Driven Hand Saw

ture which runs in two ball bearings that are packed in grease. The wide supporting shoe carries the weight of the tool, prevents tipping, and insures square cuts. By loosening the front handle, the hinged supporting shoe can easily be set for any depth of cut up to 2 inches. The device weighs, complete, only 10 pounds.

MORRIS SPECIAL DRILLING MACHINE

A special machine for drilling cast-iron hydrant pipe has recently been developed by the Morris Machine Tool Co., Court and Harriet Sts., Cincinnati, Ohio. This machine has two horizontal heads on which multiple-spindle drill heads may be mounted for drilling the ends of pipe. There is also a vertical head for drilling the side of pipe. Each main spindle is provided with an independent power feed, a dial depth gage, and an automatic trip. The latter can be set for disengaging the feed after drilling to the required depth on repetition work.

The left-hand head and the vises are adjustable along the bed to suit pipe from 3 to 9 feet in length. The vertical head is also adjustable. The spindles and quills are made of special alloy steel and heat-treated. The vise jaws are independently adjustable to take round or irregular-shaped pipe from 4 to 10 inches in diameter.

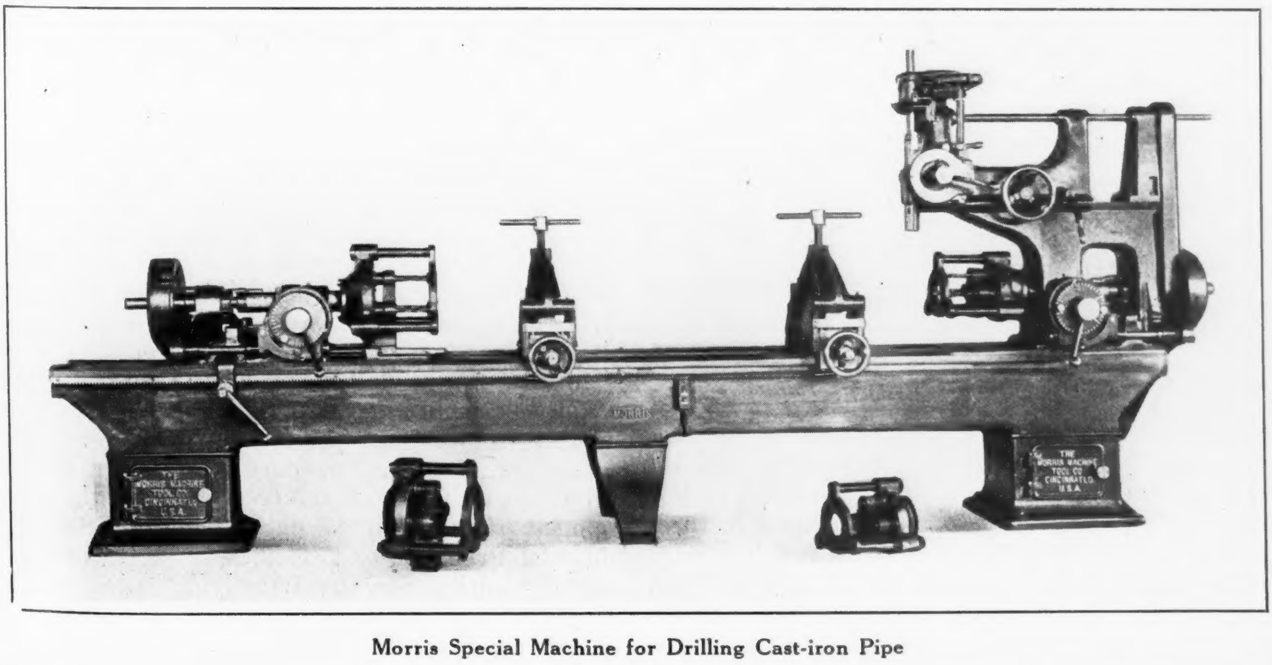
The machine is driven by a 10-horsepower motor through a chain, which delivers power to a rear shaft from which it is transmitted to the horizontal and vertical heads. The chain that transmits the drive to the vertical head is equipped with a self-adjusting idler. The drill heads are of the fixed-center type, and are provided with hardened and ground spindles and radial and thrust ball bearings. Any number of spindles can be furnished to drill holes around a bolt circle on any size pipe within the capacity of the machine.

HUNTER HIGH-SPEED CUT-OFF SAW

Small light-section beams, angle-irons, brass, copper, structural, and welded tubing, pipe, light-

Hunter High-speed Metal Saw

section pressed and drawn steel shapes, etc., may be cut cold in a No. 0 high-speed metal cut-off saw now being added to the line of products manufactured by the Hunter Saw & Machine Co., 5662 Butler St., Pittsburg, Pa. The saw blade of this machine is fully protected by steel guards, which can easily be removed for changing saws. The saw



Morris Special Machine for Drilling Cast-iron Pipe

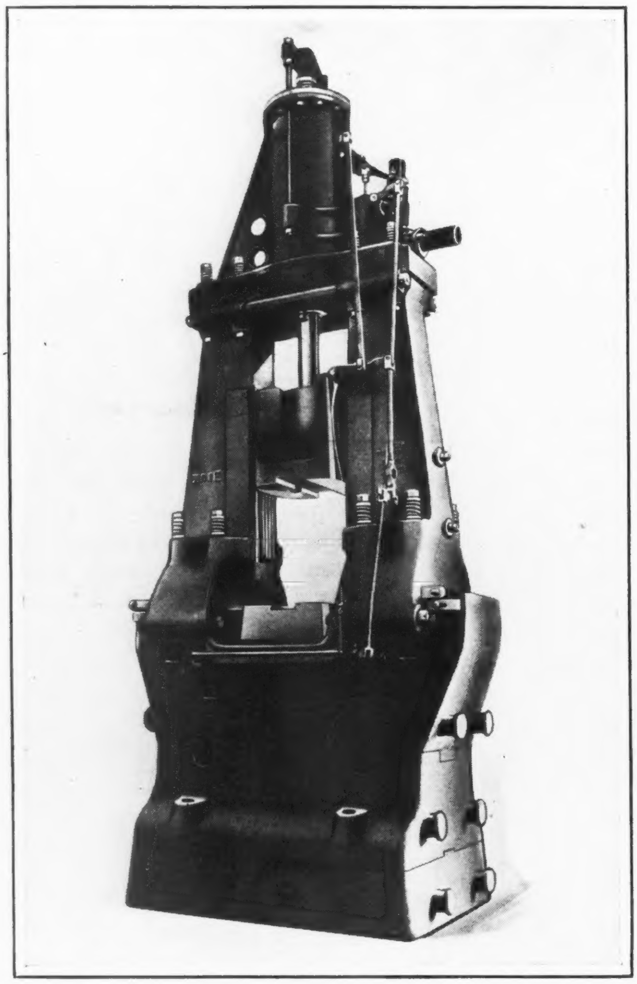
is driven by a five-horsepower ball-bearing motor, and is mounted on the motor shaft.

The tilting frame is provided with a spring cushion stop, and is connected with a spiral spring that returns the frame to the height necessary for clearing the material being cut. Feeding of the saw through the material is accomplished by means of a hand-lever attached to the tilting frame. An adjustable counterweight holds the machine in balance at all times. A quadrant stop can be set to any angle on the table within the sweep of the saw blade being used.

The machine has a capacity for cutting standard pipe up to 3/4 inch; angle-irons up to 2 by 2 by 1/8 inch; solid steel bars up to 3/4 inch; and brass and copper tubing up to 1 1/2 inches. The machine weighs approximately 900 pounds.

ERIE STEAM DROP-HAMMER

A steam drop-hammer of unusual size, embodying special features of design, was recently completed by the Erie Foundry Co., Erie, Pa. The



Erie Steam Drop-hammer Weighing 250 Tons

weight of the reciprocating parts of this machine, including the top die, is 20,000 pounds, and the total weight of the machine, approximately 250 tons. It was necessary to cast the anvil in three pieces in order to facilitate installation.

The height of the hammer over-all is 33 feet, but when installed, most of the anvil is below the floor line. The floor line comes approximately to the level of the treadle shown just below the sow block. The working face of the ram is approximately 44 inches square; the cylinder bore, 25 inches in diameter; and the rod, 9 inches in diameter. The rated stroke of the hammer is 50 inches.

Practically the entire construction consists of either steel castings or alloy-steel forgings. The frames are of box section and support the guides on five sides, no provision being made for guide adjustment. Another new feature of the design is that the bottom separators between the frames are of the drop type. The entire upper unit of the hammer can be adjusted across the anvil by means of the wedges shown, in order to align the dies and take up wear. Taper gibs provide for taking up wear at right angles to this movement.

The hammer will be used principally for the manufacture of drop-forged valve bodies at the Henry Vogt Machine Co., Louisville, Ky. It is capable of forging 8-inch valves used for high-pressure, high-temperature service, the outside diameter of these valves being about 24 inches.

* * *

SPRING MEETING OF A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers will be held at the Greenbrier Hotel, White Sulphur Springs, West Virginia, May 23 to 26. Sessions will be held on education and training for the industries, central station power, fuels, management, wood industries, hydraulics, oil and gas power, railroads, industrial power, materials handling, and machine shop practice.

The papers to be presented at the Machine Shop Practice Session are "Elastic Hysteresis Relative to Operation of Mechanical Springs," by J. K. Wood, and "Arc Welding," by J. F. Lincoln. At the management session a paper on the "Relation of Safety to Production," by L. W. Wallace, will be presented. At the materials handling session two papers will be presented, one on "The Relation of Building Design to the Manufacturing Process," by C. P. Wood, and one on "Actual Lay-out of a Building Around a Materials-handling Installation," by an author to be announced later. At the meeting, the A. S. M. E. Medal will be awarded to Wilfred Lewis of Philadelphia, Pa., for his contributions to the design and construction of gears. Mr. Lewis, in addition to many other notable achievements in gearing research, is the originator of the well-known Lewis formula.

At the regional meeting of the Society held in Kansas City, Mo., April 4 to 6, one session was devoted to education and training for the industries at which several valuable papers were read. F. W. Thomas, supervisor of apprentices of the Santa Fé Railroad, Topeka, Kan., read a paper on "Railway Apprenticeship in a National Apprenticeship Plan," and L. A. Hartley, director of education, National Founders' Association, Omaha, Neb., read a paper on the true basis for the development of foremen, the paper being entitled, "Industrial Problems or Difficulties." A third paper on "Education for the Industries" was read by P. F. Walker, Dean of the School of Engineering of the University of Kansas, Lawrence, Kan.

LARGEST TIMKEN ROLLER BEARING

Roller bearings having a bore of 42 inches and an outside diameter of 61 9/16 inches have recently been built by the Timken Roller Bearing Co., Canton, Ohio. At 30 revolutions per minute, these bearings have a capacity of 2,750,000 pounds. The weight of each bearing is more than 2 tons. Not only are these bearings the largest ever built by the company mentioned, but they will be installed by the Allis-Chalmers Mfg. Co. in the largest compeb mill in the world for manufacturing Portland cement.

Roller Bearing having a Capacity of 2,750,000 Pounds at 30 Revolutions Per Minute

One advantage derived from the use of Timken bearings in this machine will be a material reduction in the over-all length of the machine, since the Timken bearings are only 13 1/4 inches wide. Likewise, these bearings may be enclosed, and they require lubricant only at infrequent intervals. The tapered construction of the bearings permits the carrying of all loads, regardless of the direction, without the use of thrust plates or special thrust bearings.

* * *

ROLLER BEARINGS FOR MILLING MACHINE SPINDLES

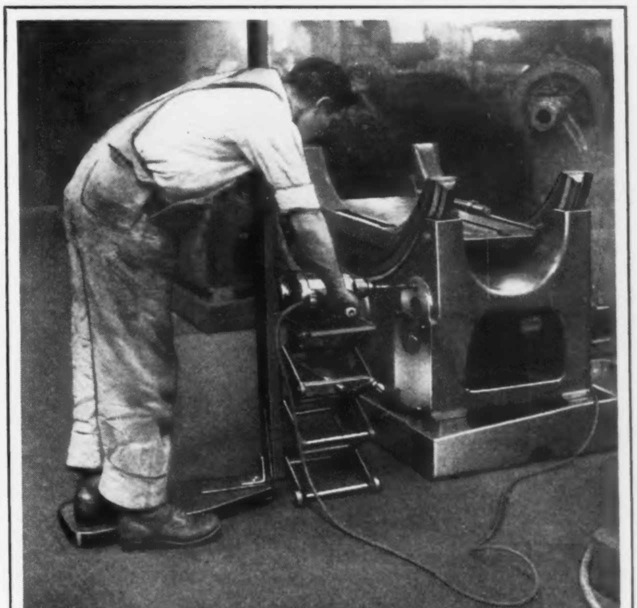
By WILLIAM J. BARNARD, Superintendent of the General Manufacturing Department of the American Type Founders Co., Jersey City, N. J.

I was very much interested in the article in March MACHINERY on the use of Timken roller bearings in the main spindle of the Kearney & Trecker milling machine. About six years ago I equipped a small Garvin milling machine in the same way. The milling machine in question had a spindle speed of 2500 revolutions per minute. It was found impossible to keep the spindle adjusted close enough at this high speed to do accurate work. The result was constant cutting of the bearings. One of the milling machines was then bored out, and a new spindle made and equipped with Timken bearings. This machine has been running at the speed mentioned for six years, with only two adjustments. We are now changing a number of our milling machines in this way, and find that they work very satisfactorily. I believe that the lapped roller bearing has a great future in the industrial machinery field.

SUPPORT FOR PORTABLE DRILLS

In using the larger sizes of portable electric and pneumatic drills, considerable fatigue is experienced by the operator if it is necessary for him to support the drill for a long period of time. It is also a difficult matter to drill holes straight unless the drill is well supported. To facilitate the use of portable drills at the Gleason Works, Rochester, N. Y., adjustable stands of the type shown in the accompanying illustration have been built for supporting the drills, while hinged wooden members of the construction shown are used for feeding the drills into the work. Both of these appliances were adopted at the suggestion of Henry M. Lucas, president of the Lucas Machine Tool Co., Cleveland, Ohio.

With this stand, it is an easy matter to support the drill horizontally in the desired plane, since the height of the stand top above the floor may be adjusted by merely turning a hand-crank. This crank is mounted on a screw having right- and left-hand threads which engage tapped holes in opposite bars of the "pantograph" links. As these bars are forced apart, the pantograph cross-links close, and the stand top is lowered toward the floor, whereas when the pantograph links are drawn together, the stand top is raised. Stands of this type are built in different sizes. In using the wooden member, the operator merely leans against the upright lever to feed the drill into the casting. Should the drill break in using equipment in this manner, the operator does not lose his balance, with possible injury as the result. The method also results in fewer broken drills.



How Portable Drills may Easily be Supported in a Horizontal Plane and Fed toward the Work

* * *

MEETING OF STEEL TREATING SOCIETY

The spring sectional meeting of the American Society for Steel Treating will be held at the Hotel Pfister, Milwaukee, Wis., May 19 and 20. Papers will be presented by a number of well-known men in the iron and steel and metallurgical fields, and many plant inspection trips have been planned.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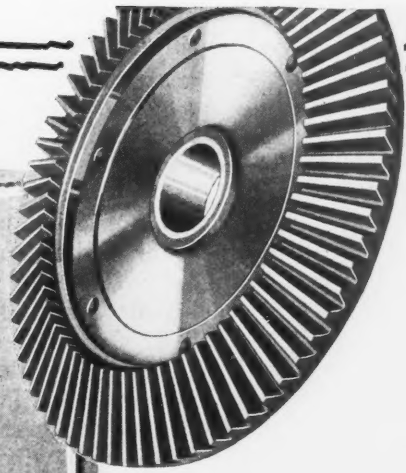

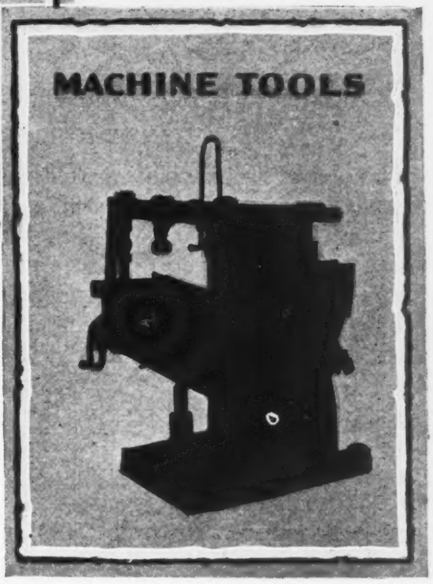

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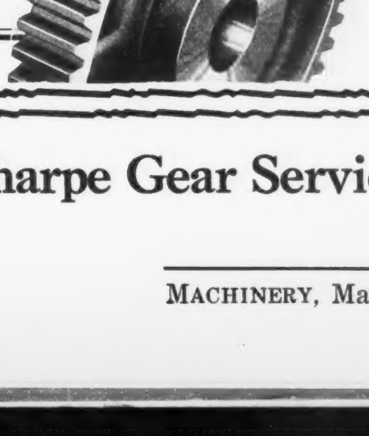

For Good Gears—use Brown & Sharpe Gear Service

IMPORTANT CHANGE IN PATENT LAW

By LEO T. PARKER

A change in the patent laws, in effect after April 14, 1927, provides for materially increasing the fees charged by the Government for filing applications. Previously the Government fees for filing applications for machines or improvements, articles of manufacture, compositions of matter, mechanical processes, and chemical processes have been $20 with the filing of the application and $20 after allowance of a patent, irrespective of the length of the specification or the number of claims.

The recent change provides for an additional charge of $1 for each claim over 20 when the application is filed, and $1 for each claim over 20 when the patent is allowed. The increased cost of obtaining a patent having 50 claims is therefore $60. In view of the fact that many complicated mechanical patents are issued with from 100 to 200 claims, the importance of being informed of this change in the law is apparent.

* * *

CLEARANCE FOR PIERCING PUNCHES

By CHARLES KUGLER

The writer read with interest the article entitled "Clearance for Piercing Punches," on page 373 of January MACHINERY. A similar trouble with slugs, which appeared to cling to the punch and drop on the face of the die, was experienced in punching stock having a coating or film of oil. The oil between the slug and the end of the punch seemed to cause the trouble, as no difficulty was experienced when the stock was free from oil.

The trouble with the oil-coated stock was eliminated, in most cases, by giving the die a side clearance of about 1/4 degree instead of the usual 1/2 degree clearance. In a few instances, the hole in the die was made straight for about 1/4 inch and then reamed with the regular 1/2-degree taper. This increased the friction between the die and the slug to such an extent that the slugs were retained in the die and caused no further trouble.

* * *

RAILWAY TOOL FOREMEN'S MEETING

The program committee of the American Railway Tool Foremen's Association has completed arrangements for topics to be presented at the fifteenth annual convention of the association to be held in Chicago August 31 to September 2, with headquarters at the Hotel Sherman. Each topic is presented by a committee consisting of a chairman and five members. The topics to be dealt with are as follows: "Standardization of Locomotive Taps and Dies," A. A. Ferguson, Missouri Pacific R. R., chairman; "Recommendations for Improving Railroad Work Through Standard Gage and Measuring Systems," M. B. Roderick, Erie R. R., chairman; "Heat-treating Methods and Equipment Recommended for Small and Large Railroad Shops," H. L. Taylor, Baltimore & Ohio R. R., chairman; and "Small Tools, Jigs and Devices for the Locomotive and Car Shops," M. Branch, Chesapeake & Ohio Ry., chairman. G. G. Macina, 11402 Calumet Ave., Chicago, Ill., is secretary of the association.

DESIGN OF TRANSMISSION SHAFTING

A code for the design of transmission shafting has just been published by the American Society of Mechanical Engineers under the procedure of the American Engineering Standards Committee. This code contains formulas and diagrams for computing shafting diameters for all conditions of loading. It contains a great deal of valuable information covering the calculation of shafting, and may be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York. The code, as published, is not yet offered in its final form, but criticisms, suggestions, and comments will be welcomed.

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LUBRICATION OF MACHINE TOOLS

An interesting and comprehensive article on automatic lubrication of machine tools appears in the March, 1927, number of *Lubrication*, published by the Texas Co., 17 Battery Place, New York City. Engineers interested in this phase of machine tool design would be benefitted by obtaining a copy of the article mentioned. It covers, first, different systems of lubrication, and proceeds to deal with pressure lubrication, grease lubrication ,and lubrication of gearing in lathes, planers, and milling machines. The lubrication of bearings, guides, and slides is then taken up, attention being given to the requirements of different types of machine tools.

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NATIONAL FOREIGN TRADE CONVENTION

The fourteenth national foreign trade convention will be held in Detroit, Mich., May 25 to 27, with headquarters at the Hotel Statler. The general sessions will be held at the Masonic Temple. At these sessions papers will be read on World's Trade Today and Tomorrow, Michigan's Vital Interest in Foreign Trade Progress, Foreign Uses for American Capital, and the Foreign Trade Balance. Group sessions will consider Foreign Credits, Import and Export Problems, Export Merchants, Advertising for Foreign Trade, Education for Foreign Trade, Export Managers, and Banking Facilities.

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A TRIP THROUGH A CLOCK FACTORY

More clocks are manufactured in Connecticut than in the remainder of the United States. This is due to the fact that in the early days the clock-making business became thoroughly identified with that state. The "father of American clock-making" was Eli Terry, who made his first clock in 1792, and who later made clocks in comparatively large quantities. For a few years Terry had two partners, Seth Thomas and Silas Hoadley, but in 1813 each of these partners started in business for himself, Seth Thomas founding what is now known as the Seth Thomas Clock Co. of Thomaston, Conn. Readers of June MACHINERY will be taken on a trip through this famous clock factory. Numerous illustrations will show the methods used in making high-grade clocks, and many interesting processes in clock manufacture will be described.

TRADE NOTES

S K F INDUSTRIES, INC., has moved from 165 Broadway, New York City, to 40 E. 34th St.

CARPENTER STEEL Co. has opened a new warehouse and office at 6215 Warren Ave. W., Detroit, Mich.

AJAX METAL Co., Frankford Ave. and Richmond St., Philadelphia, Pa., has purchased the FOLEY FURNACE Co.

TRIUMPH ELECTRIC CORPORATION, Cincinnati, Ohio, has appointed the Handlan-Buck Mfg. Co. distributor of Triumph motors in the St. Louis territory.

ADAMS & DONY, 143 Cutler Bldg., Rochester, N. Y., is a new concern established by Ogden R. Adams and Donald E. Dony to engage in the sale of machine tools.

MICHIGAN TOOL Co., 147 Jos. Campau Ave., Detroit, Mich., has purchased all the assets and good will of the CLARK CUTTER Co., 1304 Harper Ave., Detroit, Mich., and has consolidated this business with that of the Michigan Tool Co.

MERCO NORDSTROM VALVE Co. is erecting a new factory in Oakland, Calif., at the corner of 24th and Peralta Sts., which will be devoted exclusively to the manufacture of plug valves for various industries. The building will cover 30,000 square feet.

LA SALLE TOOL Co., La Salle, Ill., has removed its plant and offices to Ottawa, Ill., La Salle County. The new quarters will afford greatly increased facilities for the manufacture of La Salle plain and automatic surface grinders and American drill grinders.

MYERS-BEESON-GOLDEN, INC., has changed the name of the organization to MYERS & GOLDEN, INC. Coincident with the changing of the name, the company moves from the Pershing Square Building to new offices in the Graybar Building, 420 Lexington Ave., New York City.

LINK-BELT Co., 910 S. Michigan Ave., Chicago, Ill., has recently changed the name of the Howe truck, a small three-wheeled truck manufactured by the Howe Chain Co. of Muskegon, Mich. (one of the subsidiaries of the company), to "Jak-Tung," which is believed to be more descriptive and more easily remembered than the old name.

BAILEY METER Co., Cleveland, Ohio, is a new company which has acquired the flow meter business and patents of the General Electric Co., and the fluid meter and combustion control business and patents of the old Bailey Meter Co. The engineering, manufacturing, and sales organization of the old company will be retained by the new concern, E. G. Bailey remaining president.

M. M. NILES INDUSTRIES, Springfield, Ohio, makers of tractor hitches, garden tools and implements, have taken over the following concerns: EDWARDS BROS. Co., Leips, Ohio; BILL WEEDER Co., Sidney, Ohio; and JUDSON MFG. Co., Springfield, Ohio, and will manufacture the products of these concerns in the Niles Industries plant at Springfield, Ohio. O. J. Heimann is manager of the consolidated plant.

OLIVER MACHINERY Co., Grand Rapids, Mich., has been appointed exclusive agent and distributor for the semi-automatic wood miller manufactured by Wadkin & Co., of Leicester, England. This machine is midway in size between the Oliver No. 102 pattern milling machine and the Oliver No. 75 pattern milling machine, so that the company is now in a position to offer three sizes of this type of machine.

GENERAL ELECTRIC Co., Schenectady, N. Y., has recently opened a service shop and warehouse in Buffalo, N. Y., for the purpose of serving the electrical industry in the western part of the state. The building is of modern brick and steel construction with a sawtooth roof. There are approximately 25,000 square feet of floor space, divided equally between the warehouse and service shop, all floored with wood block.

CINCINNATI PLANER Co., Cincinnati, Ohio, has purchased from the Whipp Machine Tool Co., of Sidney, Ohio, the patterns and drawings of the Whipp 26- and 36-inch open-side crank planers, as well as the old patterns and drawings which will be used to supply repair parts to users of these machines. The new machines will be manufactured at the Oakley plant of the Cincinnati Planer Co., and will become a part of the company's regular line.

CHAMBERSBURG ENGINEERING Co., Chambersburg, Pa., manufacturer of forging hammers, presses, riveters, and pneumatic and hydraulic machinery, has appointed the Herberts Machinery & Supply Co., of Los Angeles, Cal., exclusive agent for its products in California. The Huey & Philp Hardware Co., of Dallas, Tex., has been appointed exclusive agent for Texas and Oklahoma. The Chambersburg Engineering Co. also announces the opening of offices at 613 Machinery Hall, 549 W. Washington St., Chicago, Ill., under the direction of D. M. McDowell.

FAIRBANKS Co., 416 Broome St., New York City, announces that it has assigned to Fairbanks, Morse & Co. the contract under which it has acted as the distributor of Fairbanks scales in certain territory, and has discontinued the scale branch of its business. The company will continue under its present management to develop and expand the business of manufacturing valves at Binghamton, N. Y., and trucks and wheelbarrows at Rome, Ga., and of merchandising these products, together with Dart unions.

SIMONDS SAW & STEEL Co., Fitchburg, Mass., announces its sixth annual economic contest, the aim of which is to arouse a more general interest in the subject of economics. Fifteen hundred dollars in prizes is offered by Alvan T. Simonds, president of the Simonds Saw & Steel Co., for the best essays on the subject of "Who Ultimately Pays the Taxes." The first prize is $1000 and the second prize $500. The contest closes December 31, 1927. Further information can be obtained from the Contest Editor, Simonds Saw & Steel Co., 470 Main St., Fitchburg, Mass.

HULL MACHINE & TOOL Co., Lansing, Mich., who have been designing and making special machinery, tools, dies, etc., since 1920 have recently been incorporated for $50,000. The company is at present engaged in the manufacture of tools, dies, and fixtures on a contract basis, and is installing presses, being now in a position to offer estimates for contracts in light and medium metal stampings. The officers of the newly incorporated company are S. M. Sessions, president and general manager; D. W. Sessions, vice-president, and Mrs. Bertha Hull, secretary and treasurer.

BONNEY FORGE & TOOL WORKS, Allentown, Pa., announces that it has placed on the market three new sets of wrenches. One of these, known as the Bonney No. R set, consists of ten chrome-vanadium hexagon sockets ranging from 7/16 to 7/8 inch, inclusive, and several styles of chrome-vanadium handles. The outfit is supplied in an enameled metal carrying case with leather handle. The second set—the Bonney No. 4 wrench kit—contains three right-angle chrome-vanadium wrenches of the double-end type. The third set, known as the Bonney miniature wrench set, or the No. 20 kit, contains five double-end wrenches, with ten openings ranging from 3/16 to 15/32 inch.

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NATIONAL METAL TRADES ASSOCIATION CONVENTION

The twenty-ninth annual convention of the National Metal Trades Association was held at the Hotel Statler, Detroit, Mich., April 25 and 26. Many vital issues relating to the metal industries were considered during the meeting. The results of two years' research work in industrial education and industry relations were brought before the convention, the particular subjects dealt with being pension plans and training of foremen. Among the speakers at the convention were: Honorable William H. Donovan, of Washington, D. C.; Brigadier General Ruggles, of Washington, D. C.; Virgil Jordan, of the National Industrial Conference Board; E. G. Plowman, of the Associated Industries of Massachusetts; and C. F. Klinefelter, of the Federal Board for Industrial Education. At the annual banquet, which was held Tuesday night, April 26, Honorable Charles A. Eaton, of New Jersey, was the principal speaker, his subject being "The Place of Industry in Modern Life."

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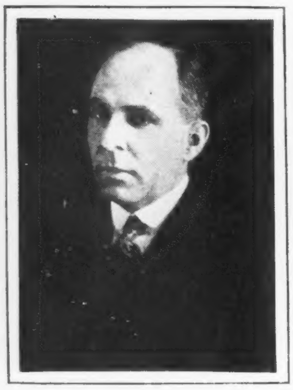
The Engineering Societies Library, 29 W. 39th St., New York City, is rendering a service of considerable value to engineers. The library comprises some 100,000 books and also receives regularly 1200 engineering periodicals from all parts of the world. A technical staff is employed to examine the books and journals as they are received, and those interested may obtain for a comparatively small fee, information about articles of special interest to them contained in the literature examined. Translations are also undertaken, and photostats of any information in the library, executed in white on a black background, and measuring 11 by 14 inches, may be obtained at a charge of 25 cents each. A black print on a white background may be obtained for a charge of 50 cents each.

PERSONALS

CLARENCE ARMS, president and general manager of the Wheeldon Wire Co. at West Brookfield, Mass., has been placed in charge of the continuous wire drawing machinery department of Sleeper & Hartley, Inc., 335 Chandler St., Worcester, Mass. Mr. Arms has had a wide experience as an engineer and wire mill executive. He was connected for ten years with the J. A. Roebling's Sons Co. at Trenton, N. J., and for eight years with the Wickwire Spencer Steel Corporation. He resigned from the latter position in order to assist the late John Wheeldon in organizing the Wheeldon Wire Co., and upon the death of Mr. Wheeldon, assumed the position of president and general manager.



Clarence Arms

WADSWORTH DOSTER, formerly sales manager of the Torrington Mfg. Co., Torrington, Conn., has been appointed assistant sales manager of the cold strip machinery department of the Mackintosh-Hemphill Co., Pittsburg, Pa., manufacturer of cold mills, heavy-duty reels, roll coilers, slitters, high-speed trimmers, straightening equipment, shears, and other auxiliaries. Mr. Doster, who was manager of the Blake & Johnson Co., Waterbury, Conn., before it was merged with the Torrington Mfg. Co., has had seventeen years experience in the designing and marketing of cold strip machinery.

J. H. COYLE, formerly supervisor of engineering of the Billings & Spencer Co., Hartford, Conn., has been placed in charge of sales engineering in New York, Pennsylvania, and New England. He will make his headquarters at Hartford. Mr. Coyle will primarily represent the company on special contract forgings and drop-forging equipment, such as drop-hammers, die-sinkers, etc., but may be called upon for engineering work in connection with any special drop-forged tools.

J. C. TERRACE, of San Francisco, Cal., has been appointed Pacific Coast field salesman for the Union Twist Drill Co., of Athol, Mass. Mr. Terrace served an apprenticeship with the Union Twist Drill Co. from 1903 to 1907, and for the last thirteen years has been connected with Fred Ward & Son, San Francisco.

F. M. MALANY, Singer Bldg., New York City, has been appointed representative in the New York district for the Stewart Die Casting Corporation, Chicago, Ill., manufacturer of die-castings and bronze bearing metal.

HENRY M. ROBINSON, president of the First National Bank of Los Angeles, Cal., was elected a director of the General Electric Co., Schenectady, N. Y., at a recent meeting of the board.

GEORGE L. BITTING has been appointed director of sales of the Bunting Brass & Bronze Co., Toledo, Ohio, manufacturer of Bunting phosphor-bronze bushing bearings and cored and solid bars. Mr. Bitting has had a wide sales experience. For the last fifteen years, he has specialized in meeting the requirements of the automotive industry. His latest previous connections were with the Standard Welding Co. and the Eaton Axle Co., both of Cleveland.

George L. Bitting

E. H. SAGER, formerly Chicago representative for the Ajax Flexible Coupling Co., Westfield, N. Y., has recently joined the sales force of Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill., and has been assigned to territory in the state of Michigan.

H. W. MARSHALL has joined the sales organization of the American Hammered Piston Ring Co., Baltimore, Md. Mr. Marshall's territory will include Kansas, Arkansas, Oklahoma, and part of Missouri.

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STEEL TREATERS FORM NEW CHAPTER

A new chapter of the American Society for Steel Treating has been organized at Dayton, Ohio, with an initial membership of 102 members, fourteen of whom are sustaining members. The first meeting was held at the Dayton Engineering Society's Auditorium on March 24, and was attended by over 250 members and guests. Frank R. Palmer, of the Carpenter Steel Co., presented a lecture entitled "Giving Tool Steels a Chance." The following officers were elected for the ensuing year: Chairman, G. J. Oswald, research department of the National Cash Register Co.; vice-chairman, O. Z. Klopsch, engineering department, Delco-Light Co.; secretary-treasurer, F. M. Reiter, industrial engineer, Dayton Power & Light Co. The Dayton chapter is the thirty-third section of the society and has established a record by starting out with the largest number of charter members of any division of the society yet organized.

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Reports for the first nine months of 1926 show that in point of value, Germany supplied 45 per cent of Italy's machinery imports; Great Britain and the United States, each 13 per cent; France, 10 per cent; and Switzerland, 8 per cent. The machinery imported from the United States was largely of high quality and high in price, the value per ton being higher than that of the machinery imported from any other country. As an example, the value per ton of American machinery in 1926 was $502, compared with $276 per ton for the French equipment imported.

COMING EVENTS

MAY 12-14—Eleventh annual meeting of the American Gear Manufacturers' Association at Jackson, Mich.; headquarters, Hayes Hotel. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

MAY 19-20—Spring sectional meeting of the American Society for Steel Treating in Milwaukee, Wis. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

MAY 21—Fourth annual convention of the National Association of Foremen in Cincinnati, Ohio. The entire day's program will be held on the grounds of the Cincinnati Zoo.

MAY 23-26—Spring meeting of the American Society of Mechanical Engineers at White Sulphur Springs, W. Va., with headquarters at the Greenbrier Hotel. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 25-27—Annual meeting of the Society of Industrial Engineers at Hotel Stevens, Chicago, Ill. George C. Dent, secretary, 608 S. Dearborn St., Chicago, Ill.

MAY 25-27—National Foreign Trade Council convention at Detroit, Mich. O. K. Davis, secretary, 1 Hanover Square, New York City.

MAY 25-28—Spring meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

JUNE 6-8—Annual convention of the American Association of Engineers at Tulsa, Okla. Acting secretary, M. E. McIver, 63 E. Adams St., Chicago, Ill.

JUNE 6-9—Annual convention of the American Foundrymen's Association to be held at Edgewater Beach Hotel, Chicago. No exhibition of equipment will be held this year in conjunction with the convention. C. E. Hoyt, executive secretary, 140 S. Dearborn St., Chicago, Ill.

JUNE 7-9—Annual meeting of the Mechanical Division of the American Railway Association at Windsor Hotel, Montreal, Quebec. There will be no exhibits of railway appliances or machinery this year. V. R. Hawthorne, secretary, 431 S. Dearborn St., Chicago, Ill.

JUNE 13-17—Twenty-second annual convention of the National Supply and Machinery Distributors' Association in conjunction with the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association, on board the Steamship *Noronic*, leaving Detroit June 13 and returning June 17. George A. Fernley, secretary, 505 Arch St., Philadelphia, Pa.

JUNE 13-18—Exposition of the Association of Iron and Steel Electrical Engineers at the Syria Mosque, Pittsburg, Pa. General chairman, John F. Kelly, 705 Empire Bldg., Pittsburg.

JUNE 20-24—Annual meeting of the American Society for Testing Materials at French Lick Springs, Ind. Secretary's address, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

AUGUST 31-SEPTEMBER 2—Annual convention of the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, Ill. G. G. Macina, secretary, 11402 Calumet Ave., Chicago, Ill.